Museum Library
AUG 3 1935
QL
640
.C78

1935, No. 2 JULY 16

COPEIA

A JOURNAL OF COLD BLOODED VERTEBRATES

Established in 1913

PUBLISHED BY
THE AMERICAN SOCIETY OF ICHTHYOLOGISTS
AND HERPETOLOGISTS

CONTENTS

AN ANNOTATED LIST OF FISHES OF THE FRESH WATERS OF PUERTO RICO. *By Samuel F. Hildebrand* 49

A GREENLAND FISH IN THE OKHOTSK SEA. *By P. J. Schmidt and A. P. Andriashev* 57

A NEW PERCOID FISH FROM PAPUA. *By J. R. Norman* 61

NOTES ON SOME ELASMOBRANCHS OF PUGET SOUND, WITH DESCRIPTIONS OF THEIR EGG CASES. *By Allan C. DeLacy and Wilbert M. Chapman* 63

HISTOLOGICAL CHANGES IN THE PROLAPSED INTESTINE OF A FISH, *Mollienisia latipinna* LE SUEUR. *By Ross Nigrelli and C. M. Breder, Jr.* 68

TWO NEW SPECIES OF *Triturus* FROM CALIFORNIA. *By Victor C. Twitty* 73

OBSERVATIONS ON THE CALIFORNIA LYRE SNAKE, *Trimorphodon vandenburghi* KLAUBER, WITH NOTES ON THE EFFECTIVENESS OF ITS VENOM. *By R. B. Cowles and C. M. Bogert* 80

THE SURVIVAL VALUE OF SPECIFIC CHARACTERS. *By Emmett Reid Dunn* 85

HERPETOLOGICAL NOTES—Hibernation of *Farancia abacura* in Captivity, *by George P. Meade*: p. 99.—Shield Variation, Reduction, and Age in a Box Terrapin, *Terrapene carolina, by C. M. Knoll*: p. 100.—Encounters with the Western Spadefoot, *Scaphiopus hammondii*, with a Note on a Few Albino Larvae, *by Wallace F. Wood*: p. 100.—Further Notes on the Reproduction of the Eastern Box-turtle, *Terrapene carolina* (Linné), *by H. E. Ewing*: p. 102.—The Desert Gridiron-tailed Lizard, *by George F. Knowlton and Clyde F. Smith*: p. 102.—The Sex Ratio in the Salamander *Hemidactylium scutatum* (Schlegel), *by Frank N. Blanchard*: p. 103.—The Western Yellow-bellied Racer in Western Washington, *by Gordon D. Alcorn*: p. 103.

ICHTHYOLOGICAL NOTES—On *Trachurus capensis* Castelnau, *by J. T. Nichols*: p. 104.—A New American Record for the Snipe fish (*Macrorhamphosus*), *by Hugh M. Smith*: p. 104.

REVIEWS AND COMMENTS—Half Mile Down: William Beebe, *by Carl L. Hubbs*: p. 105.—Notices of Books of Interest to Ichthyologists, *by Carl L. Hubbs*: p. 106.—Leitfaden zur Pflege und Zucht von Einheimischen und Fremländischen Zierfischen, Seetieren, Schnecken und Wasserpflanzen nebst einem Anhang über Trocken- und Kunst-Fischfutterarten: Wilhelm Schreitmüller, *by George S. Myers*: p. 107.—Die Aquarienfische in Wort und Bild: Max. Holly, Hermann Meinken, and Arthur Rachow, *by George S. Myers*: p. 107.—The Reptiles of China: Clifford H. Pope, *by Karl P. Schmidt*: p. 107.—A Monograph of the Frogs of the Family Microhylidae: H. W. Parker, *by E. R. Dunn*: p. 108.

EDITORIAL NOTES AND NEWS—Summary of the 1935 Meeting: p. 110.—News of Herpetologists: p. 112.—Ichthyological Items: p. 112.—Support of Copeia: p. 112.

An Annotated List of Fishes of the Fresh Waters of Puerto Rico[1]

By Samuel F. Hildebrand

THE few scattered records in the literature indicate that no thorough or general survey of the freshwater fishes of Puerto Rico had been made heretofore. The writer spent from January 28 to March 18, 1934, in Puerto Rico, studying principally the fish cultural possibilities of the island. Such a study, of course, necessitated the collection of aquatic life in the various waters. It is not claimed that the collection of fishes is exhaustive, but it does contain specimens from many localities from virtually all sections of the island. The invertebrates collected have been transmitted to the National Museum and no doubt will be assigned to various specialists for identification. The collector, himself, has studied the fishes and offers a list with notes. Included in the list are some records of specimens collected by Major Chapman Grant. Dr. Carl L. Hubbs, of the University of Michigan, has kindly sent the writer a list of the fishes taken by Major Grant for inclusion in this paper. Major Grant's collection contains the same species obtained by me, but a few additional localities and notes are supplied.

The work was carried on cooperatively by the United States Bureau of Fisheries and the Puerto Rican Department of Agriculture and Commerce. During the investigation valuable assistance was received from R. Menendez Ramos, Commissioner of Agriculture and Commerce, and from Dr. J. A. B. Nolla, Assistant Commissioner of Agriculture, both of San Juan; Wm. R. Barbour and Charles Z. Bates of the U. S. Department of Agriculture, Rio Piedras; and Luis C. Bonnet of Rio Piedras, who served as the writer's assistant. Dr. William A. Hoffman of the School of Tropical Medicine, San Juan, made notes of stomach contents of specimens of fishes examined by him principally for parasites. Doctor Hoffman's data concerning ingested foods are included in this paper with other data secured by the writer. The author is indebted to all who rendered assistance in carrying on the investigation.

The five moderately large permanent streams and several smaller ones, on the rather long northern slope, are all of interest from the standpoint of fish culture. The streams of the shorter and more abrupt southern slope are of little or no interest to the ichthyologist, since they mostly go dry during the dry season. Several artificial lakes have been made by damming streams. Some of these are not yet stocked with fish, but nearly all appear to possess the conditions essential for the support of fishes.

It is of interest to note that although little collecting appears to have been done in the fresh waters of Puerto Rico, the recent rather thorough sampling did not yield a species of fish new to the fauna. On the contrary, two species, *Ancistrus guacharote* (Cuvier and Valenciennes, 15, 1840: 508), reported simply from fresh water, and *Fundulus fonticola* Cuvier and Valenciennes (18, 1846: 198) were not taken. The type[2] and presumably the only

[1] Published by permission of the U. S. Commissioner of Fisheries.

[2] Jordan (1886: 526) reexamined the type lot of specimens on which *F. fonticola* was based, and reported that only one specimen, presumably the one on which the description was based, is a true *Fundulus*, the other specimens being "some species of *Gambusia*."

known specimen of *F. fonticola,* is reported to have been taken in a mountain spring in Puerto Rico. Poey's record (1881: 342) was based on Cuvier and Valenciennes, not on additional specimens as indicated by Evermann and Marsh (1902: 97). It is regarded as extremely doubtful whether M. Plee, the collector, actually obtained these fishes in Puerto Rico. Since he collected in other West Indian Islands, it is possible that the place of collection was incorrectly stated. Furthermore, the evidence shows that the three nominal species of *Sycidium* recorded from Puerto Rico are all referable to a single species, as explained subsequently. The result of the recent expedition and study, therefore, is that the number of indigenous species that apparently should be recognized from the fresh waters of Puerto Rico actually is reduced. Another interesting fact is that the streams, above an elevation of 1500 to 2000 feet, are uninhabited by fish, though shrimps are numerous, and crabs are also present.

Two American fishes, namely, *Lepomis incisor* (Cuvier and Valenciennes) and *Ameiurus melas melas* (Le Sueur), introduced about 1914, are well established in Comerio Reservoir and in the river at least a mile above the reservoir. A third introduced species, probably a *Pomoxis,* was said to be present, though not seen by us. These species were introduced, also, and presumably at the same time, in the Carite Reservoir, situated on the headwaters of the Rio de la Plata, where they, too, have established themselves. Catfish were observed by Major Grant at Cayey (Rio de la Plata basin), where he likewise saw fish that "looked much like Cichlasoma." The Cichlasoma-like fish very probably were bluegill sunfish. The indications, therefore, are that at least two of the introduced species have established themselves also in the streams connected with the reservoirs in which they originally were planted. *Gambusia holbrookii* Girard was introduced about 1923 for mosquito control. It has been distributed over at least the eastern end of the island and is fairly numerous in Patillas Reservoir near Patillas, and in Cayey River (Major Grant's collection). The goldfish, too, has been liberated in some of the waters of Puerto Rico. It was taken in the Guayabal Reservoir on the Rio Jacaguas and in the Guajacta Reservoir on the Rio Guajataca. It is reported to be numerous in the vicinity of Isabela. Rainbow trout eggs (*Salmo shasta*) were introduced and hatched in January, 1934, in the Luquillo National Forest. About 9,000 fry were liberated in local mountain streams. No check on the fish liberated is available to date (November 23, 1934). About 1,000 fry were held and fed in captivity. Some of the young were reported to have attained a length of upward of 7 inches on November 1, 1934. The fish have been fed wholly on shrimps caught in the local streams, except during the first several weeks when some liver and hard-boiled eggs were supplied.

The following list includes the designation of the indigenous species inhabiting the fresh waters of Puerto Rico. *Dormitator maculatus, Guavina guavina* and *Eleotris pisonis,* although included, stay in the quiet fresh and brackish water near the shore and can not be considered river fish. Several marine fishes, belonging to the genera *Mugil, Centropomus, Gerres, Caranx,* and *Doryramphus,* ascend fresh water streams in Puerto Rico sometimes to the foothills. However, these are not included as they do not properly

belong to the freshwater fauna. The local name or names, if known, follow the scientific name in the list. The arrangement and scientific nomenclature of Nichols (1929 and 1930) have been followed.

ANGUILLIDAE

1. *Anguilla rostrata* (Le Sueur)

Anguila

Muraena rostrata Le Sueur, Jour. Acad. Nat. Sci. Phila., 1, 1871: 81 (New York).

The common eel in general is not numerous. Small specimens only were taken by me as follows: Rio Grande de Añasco, near Añasco; Rio Grande de Arecibo, near Arecibo; Rio de la Plata, near Bayamon; and the Rio Canovanas, near Canovanas. It was recorded by Evermann and Marsh (1902: 68) from San Juan market, Bayamon and Mayaguez, and by Poey (1881: 344), under the name *Muraena anguilla,* without naming a locality, and by Danforth (1926: 21) from the Cartagena Lagoon near Mayaguez, where it was common and large ones upward of 40 inches in length were taken on July 5, 1924. Major Chapman Grant collected an adult in Rio Piedras, below the city filter plant.

POECILIIDAE

2. *Poecilia vivipara* Bloch and Schneider

Moroncitie

Poecilia vivipara Bloch and Schneider, Syst. Ichth., 1801: 452, l.c. 86, fig. 2 (Surinam).

This fish is common to abundant in some quiet and sluggish waters, ranging from the seashore and brackish water to the upland streams; the highest elevation at which it was taken is the Rio de la Plata at Comerio. It was also collected in the Rio Grande de Loiza at Carolina; at the mouth of a creek on the Laguna San Jose (brackish water), and in Guayabal Reservoir on the Rio Jacaguas. Evermann and Marsh (1902: 97) reported it from Ponce, Fajardo, Arroyo and Hucares; Nichols (1929: 210) recorded it from the mouth of the Loiza River and Guanica, and Danforth (1926: 21) found it by far the most abundant fish in Cartagena Lagoon near Mayaguez, stating, "They swarm in great numbers in the shallower places." Major Grant collected specimens in the Rio Coamo; in an intermittent stream 50 feet above sea level, between Cape San Juan and Fajardo; in the one intermittent stream on Culebra Island, and in a tide pool at San Juan (with marine species). Four specimens taken at Comerio, examined by Doctor Hoffman, had fed on algae, insects and insect larvae, and on small crustaceans.

The color of the specimens collected is variable: usually plain grayish green, occasionally with indications of dark cross bars in the males; side generally with a black spot somewhat in advance of the dorsal; dorsal usually punctulate with black, sometimes with an indefinite black bar at base; large males often with black at base of the upper and lower rays of the caudal.

Head 3.15 to 3.9; depth 3.2 to 3.8; eye 3.45 to 4.3; snout 3.25 to 4.5; interorbital 2.0 to 2.3; caudal peduncle 4.9 to 5.75; D. 6 or 7; A. 8; scales 25 or 26 (14 specimens measured).

This species ranges from Brazil through the West Indian Islands to

Puerto Rico. Specimens from Puerto Rico were compared with others from Brazil and Dutch Guiana. No differences of specific rank were noticed. In 14 South American specimens, having an average length of 31 mm, the head averages 3.5 in the length; the depth 3.55; the caudal peduncle 5.2; and the interorbital 2.5 in the head. In 14 specimens from Puerto Rico having an average length of 30.5 mm, the head averages 3.55 in the length; the depth 3.58; the caudal peduncle 5.25; and the interorbital 2.15 in the head. The scale and fin ray counts are identical.

MUGILIDAE

3. *Agonostomus monticola* (Bancroft)

Dajao; lisa

Mugil monticola Bancroft, in Griffith's edition of Cuvier's Animal Kingdom, Fishes, 1836: 367, pl. 36 (type locality unknown.)

The dajao, a common species and the most important food fish of the fresh waters of Puerto Rico, reaches a length of 12 inches (30 cm) or more. It ranges from sea level to an elevation of about 1500 feet. It is an active swimmer and seems to be at home equally in lowland sluggish streams and in the swift, rocky upland rivers. This fish, according to 10 specimens examined, feeds largely on insects and insect larvae, chironomid larvae commonly included, though three specimens examined had also fed on soft unrecognizable plant material, probably algae, and a few specimens contained innumerable sponge spicules. Although the walls of the stomach are rather heavy, no gizzard is formed as in the salt water mullets.

Specimens were collected as follows: Rio Grande de Añasco, at Añasco and Las Marias; Rio Bucarabones, at Maricao; Rio Grande de Arecibo, near Utuado and at Arecibo; Rio Manati, near Manati; Rio Grande de Loiza, at Trujillo Alto and Carolina; Rio Canovanas and Rio Canovanillas, at Canovanas; and Rio Magueyes, near Ponce. Evermann and Marsh (1902: 115) reported the dajao from Caguas, Bayamon, and Aguadilla; Cuvier and Valenciennes (12, 1836: 164) reported it from Puerto Rico, without naming a definite locality, under the name *Dajaus monticola*. Major Chapman Grant collected specimens from Rio Piedras, below city filter plant; "half-way up a waterfall" on St. John Island, and also saw the species in cutoff pools along an intermittent stream on Tortola Island.

A considerable variation in the depth of the body and the size of the mouth is evident. In some specimens the maxillary reaches only about to the vertical from the anterior margin of the eye, in others to or slightly past the posterior margin of the pupil. However, these differences do not appear to be of specific value. The fish from the upland rocky streams are more brightly colored (with deep blue, orange and silver) than those from the lowlands, and they also appear to be more active. Head 3.0 to 4.1; depth 3.2 to 3.8; eye 3.3 to 4.9; snout 3.05 to 5.0; maxillary 2.6 to 3.0; D. IV–I, 8; A. III, 8 or 9; scales 38 to 43 (8 specimens, 46 to 250 mm long, measured).

GOBIIDAE

4. *Gobiomorus dormitor* Lacépède.

Guavina

Gobiomorus dormitor Lacépède, Hist. Nat. Poiss., 2, 1798: 599 (Martinique; description based on a drawing by Plumier).

The name "guavina" is applied more or less indiscriminately in Puerto Rico to several species of fresh water gobies. The present species is common in all the freshwater streams fished, from sea level to an elevation of about 1000 feet. It reaches a length of about 15 inches (37.5 cm) and is of some value as a food fish. This guavina has a short, almost straight alimentary canal and no doubt is principally carnivorous. Of the 11 stomachs examined, 4 were empty. The others contained insects and insect larvae, molluscs and ostracods. Two specimens had ingested small quantities of algae, which may have been taken by accident in the capture of animal food.

Specimens were collected as follows: Rio Grande de Añasco, at Añasco and Las Marias; Rio Grande de Arecibo, at Utuado and Arecibo; Rio Manati, near Manati; Rio de la Plata, near Bayamon; Rio Grande de Loiza at Trujillo Alto and Carolina; Rio Canovanas at Canovanas, and Patillas Reservoir. It was reported by Evermann and Marsh (1902: 288) from Rio Loiza, Caguas, Bayamon, and Palo Seco. It was also recorded from Puerto Rico, under the name *Dormitator mugiloides* by Poey (1881: 339), without naming a locality. Major Chapman Grant took specimens in Rio Piedras, below the city filter plant.

Head 3.0 to 3.5; depth 5.5 to 6.0; eye 6.3 to 9.0; snout 3.1 to 4.0; maxillary 2.4 to 2.75; D. VI–I, 9 or 10; A. I, 9 or 10; scales 63 to 67 (5 specimens ranging from 95 to 270 mm in length measured). Specimens from Puerto Rico and Panama were compared and appeared to be identical.

5. *Dormitator maculatus* (Bloch)

Sciaena maculata Bloch, Naturgesch. Ausland. Fische, 1790: pl. 299, fig. 2 (West Indies).

This species has been taken only in sluggish water at or near sea level and does not properly belong to the river fishes of Puerto Rico.

Specimens were taken only near the mouth of a small creek on the Laguna San Jose. It was reported from Mayaguez and Hucares by Evermann and Marsh (1902: 289), and from San Juan and Guanica by Nichols (1930: 360). Major Chapman Grant took large adults in Rio Piedras just below the city filter plant, and one young, along with marine species, in a tide pool at San Juan.

6. *Guavina guavina* (Cuvier and Valenciennes)

Guavina

Eleotris guavina Cuvier and Valenciennes, Hist. Nat. Poiss., 12, 1837: 223 (Martinique).

This species was recorded from Puerto Rico by Evermann and Marsh (1902: 290) on the basis of 2 specimens seen in the San Juan market, believed to have been caught at the mouth of Bayamon River. It was not seen by me nor by Major Grant. It evidently is confined to fresh and brackish water near the shore, where little collecting was done on the recent expedition.

7. *Eleotris pisonis* (Gmelin)

Moron

Gobius pisonis Gmelin, Linn. Syst. Nat., 1788: 1206 (Brazil).

As this fish does not ascend streams, it does not properly belong to the river fishes of Puerto Rico. It was taken only in standing or sluggish water

near the sea as follows: Rio Grande de Arecibo, at Arecibo; Rio de la Plata near Bayamon, and near the mouth of a creek on the Laguna San Jose. Evermann and Marsh (1902: 291) recorded it from the Bayamon River, Mayaguez and Arroyo. Nichols (1930: 361) reported it from Guanica. Poey (1881: 339) recorded it, under the name *E. gyrinus*, from Puerto Rico without naming a locality. Major Chapman Grant collected specimens in Rio Piedras, below the city filter plant.

8. *Chonophorus taiasica* (Lichtenstein)

Oliva; guavina

Gobius taiasica Lichtenstein, Berl. Abhandl., 1822: 273 (Brazil).

This goby occurs in the streams from sea level up to an elevation of at least 1000 feet. In the upland streams it frequents rocky pools where it is difficult to catch. It reaches a length of at least 12 inches. Three specimens, examined for ingested food by Doctor Hoffman, were found to have fed on insects and insect larvae, principally chironomid larvae. One stomach contained numerous diatoms, two contained some filamentous algae, and one a small crustacean.

Specimens were collected as follows: Rio Grande de Arecibo, at Utuado and Arecibo; Rio de la Plata, near Bayamon; Rio Grande de Loiza, at Trujillo Alto; Rio Canovanas and Rio Canovanillas, at Canovanas, and Rio Guayo near Juana Diaz. This goby was reported from Bayamon and Caguas by Evermann and Marsh (1902: 298), from Guanica by Nichols (1930: 367), and from the Cartagena Lagoon by Danforth (1926: 21). Major Grant obtained this species in Rio Piedras, below the city filter plant.

Specimens from Puerto Rico were compared with others from Haiti and Panama, from which they appeared to be inseparable specifically.

Head 3.3 to 3.9; depth 5.1 to 6.5; eye 3.6 to 8.2; snout 2.0 to 2.75; interorbital 6.8 to 13; maxillary 2.2 to 2.8; D. VI–I, 10; A. 11; scales 68 to 73 (6 specimens, 48 to 225 mm long, measured).

9. *Sicydium plumieri* (Bloch)

Guavina

Gobius plumieri Bloch, Ichthyol., 1786: 125, pl. 178, fig. 2 (Martinique; description based on a drawing by Plumier).

Three nominal species of this genus, namely *plumieri, antillarum* and *caguitae*, have been reported from Puerto Rico. However, a careful study of the numerous specimens collected, in comparison with the type of *S. caguitae* (Evermann and Marsh, 1899: 355; 1902: 292), the description and figure of *S. plumieri* by Bloch (1786: 125), the description and figure of *S. antillarum* by Ogilvie-Grant (1884: 157), and specimens from Haiti, convinces the writer that all specimens reported from Puerto Rico to date are referable to a single species, *Sicydium plumieri*. *S. buscki* Evermann and Clark (1906: 854), too, should be added to the synonymy of *S. plumieri*, as shown subsequently.

S. caguitae, according to the first describers, is supposed to differ from *S. plumieri* in being more completely scaled, in having shorter pectorals, nonfilamentous dorsal spines, and in color. A study of specimens shows that squamation is about equally complete. However, in some individuals the scales are imbedded or indefinitely visible anterior to the first dorsal, whereas

in others they are exposed. The indefiniteness or invisibility of the scales anteriorly in some individuals and the irregularity of the series undoubtedly has led to the large difference in scale counts noted in descriptions.

The differences in length of the pectoral fins and the dorsal spines evidently are secondary sexual characters, as determined by the examination of the internal organs of 13 adults. Eight of these specimens, which have short dorsal spines, failing to reach the origin of the second dorsal when deflexed, are clearly all females. The other 5 specimens, which have long dorsal spines, reaching to or beyond the origin of the second dorsal, are males.

The color is very variable. Some specimens are plain olivaceous, and others are bluish black. The lighter specimens frequently have dark cross bars on the body, which rarely extend on the caudal fin. Some specimens have a dark lateral band, which may be continuous or broken. Large males, according to specimens at hand, are plain bluish black; large females are lighter, with or without bars. Therefore, *S. caguitae* clearly is the female, whereas the original description and figure of *S. plumieri* were based on a male specimen.

According to Ogilvie-Grant (1884: 157), *S. antillarum*, recorded from Puerto Rico by Silvester (1915: 216), differs from *S. plumieri* chiefly in that the former has teeth "cut through the gums," whereas in the latter they are "almost entirely hidden." Whether the teeth show through the gums evidently depends largely upon the preservative used. If specimens are preserved in strong alcohol the gums shrink away from the teeth, whereas weak alcohol or formalin has a tendency to leave the gums around the teeth. Therefore, the supposed difference is of no specific value. The original description and figure of *S. antillarum*, like those of *S. plumieri*, were based on a male specimen.

The writer examined the type of *S. buscki* Evermann and Clark (1906: 854), from San Francisco Mountains, Santo Domingo. This type appears to agree perfectly with female specimens from Puerto Rico. The dorsal and anal fin ray counts are incorrectly stated in the original description and wrongly shown in the figure by the authors as VI–I, 8 for the former fin and I, 7 for the latter. The correct counts are D. VI–I, 10; A. I, 10. Therefore, *S. buscki*, also, should stand as a synonym of *S. plumieri*.

This goby was seen and taken only in rocky streams, which it ascends to a higher elevation than any other goby in Puerto Rico. It reaches a length of only about 4½ inches (112 mm) and is quite numerous in some localities. It clings to stones so tightly with its round cup-shaped sucking disc that it is very difficult to seine. It is fully able to support its weight out of water when allowed to attach itself to the hand. This goby has a long convoluted intestine, measuring 230 mm in length in a specimen 55 mm long. The fish evidently subsist chiefly on plants. The contents of the intestinal tract of 8 specimens examined consisted chiefly of vegetable debris including diatom shells, though one specimen had ingested a few molluscs, another one a chironomid larva and an ostracod, and still another one contained many sponge spicules.

Specimens were collected as follows: Rio Grande de Añasco, near Las Marias; Rio Blanco, at Lares; Rio de la Guava, at Maricao; Rio Grande

de Arecibo, at Utuado; Rio Canovanas, at Canovanas; and Rio Magueyes, at Ponce. *S. plumieri* was recorded from the "Anaguabo" River (probably meaning the Rio Blanco de Naguabo) by Cuvier and Valenciennes (1837: 168); *S. caguitae* by Evermann and Marsh (1899: 355; 1902: 291) from Caguas; and *S. antillarum* by Silvester (1915: 216) from Utuado. The recorded by Poey (1881: 338) is based on Cuvier and Valenciennes' record, already cited, and is not the original record of this species from Puerto Rico, as indicated by Evermann and Marsh (1902: 292) and Nichols (1930: 363). It was taken also by Major Grant about 10 kilometers south of Canovanas, in a tumbling torrent subject to great floods but always running.

Head 4.2 to 4.8; depth 4.8 to 6.6; eye 4.1 to 7.2; snout 2.1 to 2.9; interorbital 2.8 to 4.0; caudal peduncle 1.7 to 2.2; D. VI–I, 10; A. I, 10; scales about 65 to 80 (14 specimens 46 to 102 mm long, measured); vertebrae 11 + 14 = 25 (one specimen examined). Of 13 adults examined, taken between February 16 and March 12, one female was gravid. The rest showed no signs of advanced development.

Literature Cited

Bloch, Marc E.
1785–1788 Ichthyologie ou histoire naturelle, generale et particuliere des poissons, 12 vol., 452 pls.

Cuvier, George, and Valenciennes, Achille
1828–1849 Histoire naturelle des poissons, 22 vol., 620 pls.

Danforth, Stuart T.
1926 An ecological study of Cartagena Lagoon, Porto Rico, with special reference to birds. *Jour. Dept. Agri., Porto Rico*, 10(1): 136 pp. (Fishes mentioned on p. 21).

Evermann, Barton W., and Clark, H. Walton
1906 New fishes from Santo Domingo. *Proc. U. S. Nat. Mus.*, 30: 851–855.

Evermann, Barton W., and Marsh, Millard C.
1900 Descriptions of new genera and species of fishes from Porto Rico. *Rep. U. S. Fish Comm.*, 1899: 351–362.
1902 The Fishes of Porto Rico. *Bull. U. S. Fish Comm.*, 20 (1), 1900: 49–350, 112 text figs., 49 pls.

Jordan, David Starr
1886 Notes on typical specimens of fishes described by Cuvier and Valenciennes and preserved in the Musee d'Histoire Naturelle in Paris. *Proc. U. S. Nat. Mus.*, 9: 525–546.

Nichols, J. T.
1929–1930 The fishes of Porto Rico and the Virgin Islands. Scientific Survey of Porto Rico and the Virgin Islands, New York Academy of Sciences, 10 (2): 161–295; and 10 (3): 299–399.

Ogilvie-Grant, W. R.
1884 A revision of the fishes of the genera Sicydium and Lentipes, with descriptions of five new species. *Proc. Zool. Soc. London*, 1884: 153–172, 2 pls.

Poey, F.
1881 Pesces (In Gundlach, Apuntes pora la fauna puerto-riquena). *Anales de la Sociedad Española de Historia Natural*, 10: 317–350.

Silvester, C. F.
1915 Fishes new to the fauna of Porto Rico. *Yearbook Carn. Inst. Wash.*, 14: 214–217.

United States Bureau of Fisheries, Washington, D.C.

A Greenland Fish in the Okhotsk Sea

By P. J. Schmidt and A. P. Andriashev

In 1904 the senior author, in his *Fishes of the Eastern Seas* described a presumably new fish of the family of Blenniidae found near Cape Terpenija of the Okhotsk Sea, as *Ernogrammus storoshi*, sp. n. In describing this species the author especially stressed the point that it differs from all other known Pacific fishes referred to the Blenniidae in the structure of its anal fin, which not only has 2 spines before the soft rays, but also 2 behind them. Later this fish was found by different Russian expeditions in other regions of the Okhotsk Sea and in the northern part of the Bering Sea.

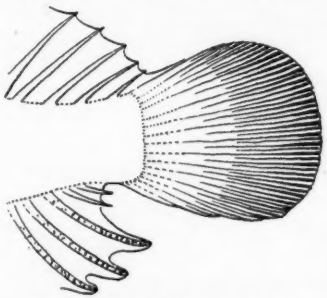


Fig. 1. Spines in the anal fin of *Eumesogrammus*

In studying at the present time the fishes of the Okhotsk and Bering seas, collected by expeditions of the Pacific Scientific Institute of Fisheries (Vladivostok) in 1932, we have discovered that the distribution of *Ernogrammus storoshi* reaches to the Bering Strait, and have presumed that this fish may perhaps be identical with the very little known *Chirus praecisus* Krøyer (1837), described about one hundred years ago from Greenland. That species is also armed with 2 spines in the posterior part of its anal fin.

Although the old-fashioned but rather detailed description of Krøyer, in Danish, corresponded in general to the features observed in our specimens, still some doubts remained about the identity of the nominal species, especially as no illustration was given by the eminent Danish ichthyologist to supplement his description. These doubts were removed by Prof. Ad. S. Jensen of Copenhagen, who kindly compared two specimens of *Ernogrammus storoshi* Schmidt, that we sent him, with the type-specimens of Krøyer's *Chirus praecisus*, kept in the Zoological Museum of the University of Copenhagen. He found that our specimens belong to the same species, as no differences in the number of rays, measurements, general structure or color, could be detected. We take the opportunity to express here our heartiest thanks to Prof. Jensen for his kind assistance in elucidating this interesting question.

The presence of 2 or 3 spines behind the soft rays of the anal fin (undeveloped in either *Stichaeus* or *Ulvaria*) and the distinctive structure of the lateral lines in this species completely justified the creation of the new genus *Eumesogrammus* by Gill (1864). Therefore the scientific name of this fish is *Eumesogrammus praecisus* (Krøyer). We give here a new description and an illustration of this little known species, with some observations on its distribution and ecology.

Eumesogrammus praecisus (Krøyer, 1837)

Figs. 1 and 2

Chirus praecisus Krøyer, Ichthyologiske Bidrag. I. Naturh. Tidskr. 1, 1837: 25–32.
Clinus unimaculatus Reinhardt, K. Danske Vidensk. Selskab. Abhandl., 7, 1838: 121.
Eumesogrammus praecisus Gill, Proc. Acad. Nat. Sci. Phila., 16, 1864: 210. Jordan and Evermann, Fishes of North and Middle America, 3, 1898: 2441.[1] Jordan, Evermann, and Clark, Rep. U. S. Comm. Fish., 128, pt. 2 (1930): 470. Vladykov, Contr. Can. Biol. and Fish., 8 (2), 1933: 23 (Hudson Bay).
Ernogrammus storoshi Schmidt, Pisces Mar. Orient. Imp. Ross., 1904: 193. Soldatov and Lindberg, Bull. Pac. Sci. Fish. Inst., 5, 1930: 464.

D. XLVII to XLIX (L); A. II, 29 to 32, II or III; P. 17 or 18; V. I, 3.

Body compressed, its depth 5 to 6 in length without caudal fin; head large, 4 to 5 in the same length, its upper profile nearly straight. Mouth subhorizontal, large; end of maxillary below center of eye; lower jaw slightly projecting. Eye large, its diameter nearly equal to length of snout. Interorbital space narrow, of approximately same width as diameter of pupil.

TABLE 1
PROPORTIONATE MEASUREMENTS OF *EUMESOGRAMMUS PRAECISUS*

	Okhotsk Sea (8 specimens)	Bering Sea (34 specimens)	Greenland From Ad. S. Jensen
Total length in mm	102.5 to 164.5	85.0 to 150.0	.....
Depth of body in % of body length without caudal	14.8 to 19.0	16.0 to 21.0	18.1 to 20.8
Length of head	23.7 to 27.4	20.0 to 25.8	24.4 to 25.0
Length of pectoral fin	16.8 to 18.8	16.0 to 20.2	.....
Diameter of eye in % of length of head	21.7 to 25.2	20.0 to 27.0	.....
Length of snout	20.4 to 25.7	20.8 to 27.3	.....
Length of maxillary	35.0 to 44.8	.....	.....

Many pores on the head located in groups: 2 pores in the interorbital space before the eye and 3 behind the eye, 5 postocular pores, 2 longitudinal rows of 8 pores each on the occiput, a subocular row of 10 to 11 and a preopercular and mandibular row of 10 pores. One pair of short nasal tubes. Teeth small, conical on jaws, vomer and palatines.

Lower lip interrupted; its anterior half on each side enlarged in a lobe, connected with the skin of the symphysis. A palatine membrane and a membrane on the lower jaw present. A band of papillae behind the teeth of both jaws and around the vomer and palatines.

Gill-opening directed downward and forward. Gill-membranes united, with a triangular incision, connected with the isthmus anteriorly. Gill-rakers short, about 12 on the first gill-arch. Branchiostegals 6.

Body covered with cycloid scales; head naked. Two lateral lines, each with two branches. The first or upper line represents a continuation of the postocular row of pores and divides into two branches behind the gill-opening. The dorsal branch extends over 2/3 of the body length and gives off in its anterior part some short vertical branches, of 2 to 5 pores each, extending toward but not to the dorsal fin. The lower branch, forming the chief

[1] The fin formula given here is D. XLIX; A. 34; V. 3; the most especial peculiarity—the presence of two spines behind soft rays—was overlooked, although mentioned in the original description.

lateral line, and lying along the median line of the side of the body, fails to reach the caudal fin by about two snout lengths. The ventral line begins before the ventral fins and divides below the base of the pectoral fin into two branches; the upper of which reaches nearly to the middle of the anal fin, while the lower branch, situated on the belly, reaches to the anus. The pores of the lateral lines are not always equidistant; sometimes the lines are interrupted and curved.

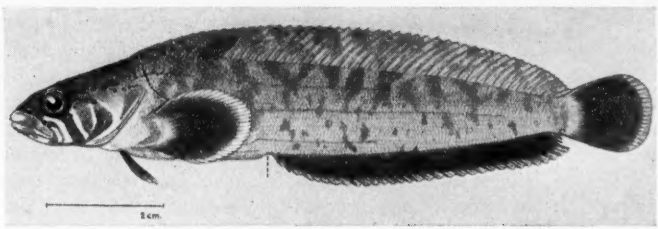


Fig 2. *Eumesogrammus praecisus* Krøyer. Bering Sea.

The dorsal fin, low at its beginning above the gill opening, gradually increases in height toward the middle and is connected posteriorly with the caudal fin by a membrane, which overlaps one-fifth of the length of the caudal. Anal fin with two short spines anteriorly; its soft rays with free tips; 2 or 3 of the last rays are transformed into short spines (Fig. 1); membrane connected with base of caudal fin. Pectoral fins long, almost reaching to the vent, rounded; rays all branched. Ventral fins with one concealed spine and 3 soft rays, placed before the pectorals.

Body gray-brown, yellowish below. A series of irregular and sometimes indistinct dark bands on the sides, disrupted into spots on the lower sides. Head dark; a dark oblique band from the eye, directed downward and backward, is bordered on each side by a narrow whitish band; whitish spots on the jaws and on the opercle. Dorsal fin gray-brown with indistinct darker spots and a large dark ocelliform spot between its 6th and 10th spines. Pectoral, anal and caudal fins dark, with whitish marginal bands.

Pyloric caeca 5. Vertebrae 52 (126 + 36). Length of full-grown specimens from the Bering Sea, 85 to 150 mm; of mature males from the Okhotsk Sea, 127.5 to 164.5 mm; of mature females from the same sea, 102.5 to 130.5 mm.

A careful comparison of measurements in hundredths of body length (without caudal fin), given in Table 1, shows that no difference can be found between specimens from the Okhotsk Sea and those from the Bering Sea.

Distribution and Ecology.—In the Okhotsk Sea *Eumesogrammus praecisus* (Krøyer) was found exclusively in its northern part, to the north of 50° N. Lat.; on the east coast of the Sakhalin Island; near St. Jonas Island; in Penshina and Tauiskaya bays; near Ayan, and on the west coast of Kamtchatka (at 57° 56′ N., 156° 46′ 05″ E.). Its habitat is here chiefly limited to depths between 55 and 130 meters, and to low temperatures, mostly below 0°C.

In the Bering Sea the species was found by the junior author at 13 stations during the 1932 cruise of the trawler "Dalnewostochnik" to the northern part of this Sea and in the Bering Strait, but it does not appear to penetrate into the eastern part of the Bering Sea or to go west of Bering Strait to Chukotsk Sea. This fish was here found to abide mostly at depths of 40 to 70 meters, but was sometimes taken in water as deep as 142 meters. It is chiefly restricted to rocky and pebbly grounds and was never found, at least in the Bering Sea, on sandy or oozy grounds. Here it seems to prefer temperatures above 0°C, as is shown by Table 2. It was found in this Sea mostly in water of 32.0 to 33.3 *pro mille* salinity and is especially abundant in those regions where the sea currents are strong, for example in Bering Strait. Unfortunately we know almost nothing about the life and distribution of this fish in Greenland waters, but it seems that it is found there only on the west coast, as it is mentioned in the *List of Fishes of Greenland* by Ad. S. Jensen[2], and is omitted in his list of fishes from the east coast of Greenland[3]. It has recently been recorded by Vladikov (1933) from Hudson Bay.

TABLE 2. TEMPERATURES OF WATER AT THE COLLECTING STATIONS OF *EUMESOGRAMMUS PRAECISUS* IN THE BERING SEA

	Temperature in degrees Centigrade							
	Below −1.0	-1.0 to 0.0	0.0 to 1.0	1.0 to 2.0	2.0 to 3.0	3.0 to 4.0	4.0 to 5.0	Totals
Number of specimens	2	6	13	39	17	1	1	79
Number of stations	1	1	1	4	4	1	1	13

Most Arctic species of fishes common to the Pacific and Atlantic are found on the northern coasts of Europe and Asia—in the Chukotsk Sea, Arctic Ocean, Kara and Barents seas. Very few Pacific species inhabit the American and Greenland coasts without penetrating farther to the east into European Arctic waters. *Hemitripterus americanus* (Gmelin), which does not differ from *H. villosus* (Pallas) of the Pacific, and *Stichaeus punctatus* (Fabricius), known from Labrador, the west coast of Greenland and the Bering, Okhotsk and Japanese seas, but absent to the west of the Bering Strait, constitute two examples of this distribution pattern. As the third example we now have *Eumesogrammus praecisus* (Krøyer).

ACADEMY OF SCIENCES, LENINGRAD, U.S.S.R.

[2] Investigations of the "Dana" in West Greenland Waters, 1925. *Rapp. et Proc.-Verb., Cons. Intern. Explor. Mer*, 39, 1926: 102.
[3] Meddelels. om Grönland, 29, 1904: 216.

A New Percoid Fish From Papua

By J. R. Norman

Synechopterus, gen. nov.

BODY compressed, covered with cycloid scales of moderate size; lateral line complete, continuous, concurrent with the dorsal profile, each tube straight, not extending the whole length of the scale. Anterior profile scarcely notched above eyes. Mouth moderate, a little protractile, the gape not very oblique; maxillary exposed, without supplemental bone; jaws equal anteriorly. Several series of conical teeth in each jaw, those of the outer row somewhat enlarged; a patch of similar teeth on the vomer and a single row on each palatine; no teeth on the tongue. Cheek and operculum scaled.

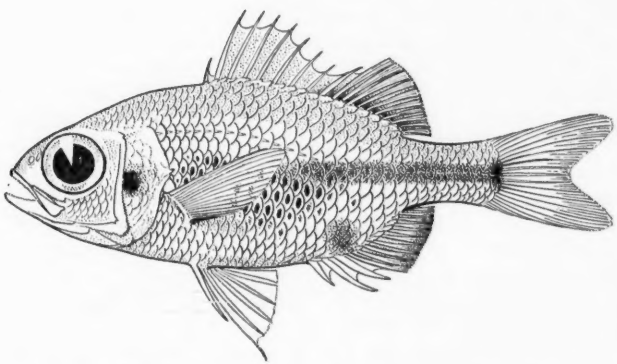


Fig. 1. *Synechopterus caudovittatus.* Holotype. Natural size.
Drawn by Mr. A. Fraser-Brunner

Praeorbital serrated; orbital rim without serrae; praeoperculum with a double edge, the outer serrated on its posterior and lower edges, the inner with one or two serrae at the angle; interoperculum scarcely serrated; operculum not spinate. Gill-membranes united far forward, free from the isthmus; 6 branchiostegals; pseudobranchiae present; gill-rakers of moderate length. A single dorsal fin, the spinous portion longer than the soft and with 9 spines, preceded by a short recumbent spine, directed forward, hidden beneath the scales; anal with 3 spines, similar to soft dorsal; both fins with a single row of scales at the base. Pectorals asymmetrical, with 14 rays, the upper longest. Pelvics inserted just behind pectoral base, each with a rather slender spine; a scaly axillary process (?).[1] Caudal forked.

Genotype—*Synechopterus caudovittatus,* sp. n.

[1] The scales are much worn in this region, and it is impossible to be sure of the presence of this process. Such a process is present in the closely related genus, *Tetracentrum.*

Synechopterus caudovittatus, sp. n.

Depth of body 2.6 in the length, length of head about 3. Upper profile more or less evenly curved anteriorly. Snout shorter than eye, diameter of which is 2.67 in length of head and nearly 1.5 times the interorbital width. Maxillary not reaching middle of eye. 14 gill-rakers on lower part of anterior arch. 32 scales in lateral line: 4.5 between latter and origin of dorsal; 3 series of scales on cheek. Dorsal IX, 10; commencing a little behind axil of pectoral; first spine small; second, third and fourth subequal, about 0.5 length of head; thence decreasing in length to the eighth, which is about 0.75 as long as the ninth; anterior soft rays longest, about equal to second spine. Anal III, 10; second and third spines subequal, 0.4 length of head, about twice as long as first spine. Pectoral 1.4 in length of head; pelvics longer, first ray a little prolonged, just reaching origin of anal. Yellowish brown above, silvery below; a black blotch on the operculum; a patch of scales on middle of side with black centers; a broad black longitudinal band extending from below middle of spinous dorsal to base of caudal, its posterior part covering the lateral line; a black blotch above the anterior part of the anal; spinous dorsal more or less dusky; soft dorsal with blackish base and with the distal parts dusky; soft rays of anal dusky toward their edges; posterior part of caudal darker; pectorals and pelvics uniformly yellowish.

Described from a single example, 95 mm in total length, from Kokoda, Papua (1200 feet); collected and presented to the British Museum (Nat. Hist.) by Miss L. E. Cheesman, Reg. No. 1934.4.7.16.

This fish is clearly related to *Tetracentrum* Macleay, a genus described in 1883[2] and not since recognized. In Vol. 5 of their *Fishes of the Indo-Australian Archipelago,* Weber and Beaufort expressed some doubt as to the systematic position of *Tetracentrum,* placing it as a doubtful genus at the end of the family Centropomidae and close to *Ambassis.* Dr. L. F. de Beaufort, who has kindly examined the fish described above, agrees with me as to its proximity to *Tetracentrum* and its apparent relationship to *Ambassis.* Through the kindness of Mr. G. P. Whitley of the Australian Museum, I have received one of Macleay's cotypes of *Tetracentrum apogonoides* (85 mm), of which six are preserved in that institution, together with a drawing of the logotype of the species selected by him (about 150 mm) and some notes on the specimens. I take this opportunity of offering my best thanks to Mr. Whitley for his courtesy in allowing me to make use of these data, which are to be included in a paper by him on the Australian ambassids now in the press. Examination of the cotype confirms its close relationship with the fish now described, but the two appear to be sufficiently distinct to warrant generic separation. *Synechopterus* may be distinguished from *Tetracentrum* mainly by the different shape of the upper profile of head and nape (probably accompanied by differences in the form of the occipital region of the skull), the smaller number of teeth in the jaws, the absence of serrae on the interoperculum and on the orbital rim, the more posterior insertion of the pelvic fins, and especially by the presence of 3 instead of 4 anal spines. Both genera differ from *Ambassis* in the continuous dorsal

[2] Proc. Linn. Soc. N. S. Wales, 7: 256. Genotype—*T. apogonoides* Macleay. Goldie River and other freshwater streams of New Guinea.

fin, the low scaly sheath at the bases of the dorsal and anal fins, and in a number of smaller characters.

Regan[3] includes *Ambassis* with *Centropomus, Lates* and related genera in the family Centropomidae, in which the pelvic fin has a scaly axillary process. Pending a thorough study of the osteology of *Tetracentrum* and *Synechopterus,* these genera may be provisionally placed with *Ambassis,* to which they appear to be most nearly related.

British Museum (Natural History), Cromwell Road, London, S.W. 7, England.

Notes on Some Elasmobranchs of Puget Sound, with Descriptions of Their Egg Cases

By Allan C. DeLacy and Wilbert M. Chapman

During the winter and summer of 1932–1933 the authors made collecting trips at regular intervals on the shrimp trawler "Audrey", working out of Everett and Seattle on Puget Sound, Washington. From time to time egg cases and many interesting adults of different elasmobranch fishes have been found in the abundant material brought up by the 24-foot beam trawl. It is upon this material, and additional specimens collected by the authors at the Oceanographical Laboratories of the University of Washington, Friday Harbor, Washington, that the present report is based. The authors wish to thank Captain and Mrs. Haines of the "Audrey" for their cordial cooperation and interest in this work.

Apristurus brunneus (Gilbert)

Two specimens of this species have been reported upon in the literature: the type specimen, a female, from the Gulf of California[1], and a female from Hoods Canal, Puget Sound[2]. 22 specimens of this species, 7 males and 15 females, ranging in length from 368 to 500 mm., were taken by the "Audrey" in Saratoga Passage and along the east side of Camano Island. Since the current descriptions of *A. brunneus* are more or less incomplete we give the following detailed account of our specimens, which are catalogued in the Collection of Fishes, Department of Fisheries, University of Washington (Cat. Nos. 2921 to 2923, 2933 and 3137).

Measurements in hundredths of the total length: tip of snout to first gill slit 17.1 to 21.2 (average 19.3), preocular length of snout 8.0 to 11.1 (9.4); tip of snout to spiracle 11.6 to 14.7 (13.1); longitudinal diameter of eye 2.8 to 3.6 (3.1); width of spiracle 0.6 to 1.0 (0.8); greatest width of snout 7.5 to 10.4 (9.2); interorbital width 6.2 to 7.9 (7.1); width of head behind spiracles 9.8 to 12.5 (11.2); tip of snout to labial angle 11.6 to 14.9 (12.9); preoral length of snout 6.6 to 9.2 (7.8); width between outer labial angles 7.8 to 10.2 (9.1); distance from outer labial angle to the symphysis 4.8 to 6.2 (5.5); length of upper labial fold 2.4 to 3.8 (3.2); length of lower labial fold 1.8 to 2.7 (2.3); distance between inner ends of nostrils 2.6 to 3.5 (3.2);

[3] Ann. and Mag. Nat. Hist., (8) 12, 1913: 119.
[1] Gilbert, C. H. Proc. U. S. Nat. Mus., 14 (880), 1892: 542–543.
[2] Gilbert, C. H., and Thompson, J. C. Proc. U. S. Nat. Mus., 28 (1414), 1905: 975–976.

snout to origin of pectorals 22.8 to 26.3 (24.1); snout to origin of pelvics 41.9 to 49.0 (46.1); snout to origin of anal 56.2 to 63.4 (59.2); snout to first dorsal 48.6 to 54.2 (50.7); snout to second dorsal 61.9 to 68.1 (64.6); snout to anus 44.2 to 55.2 (50.3); length of first dorsal 8.4 to 11.8 (9.8); length of anal base 10.3 to 15.1 (13.1); greatest height of anal 3.7 to 5.6 (4.8); greatest length of pectoral 10.2 to 13.8 (12.2); greatest length of pelvic 10.2 to 12.6 (11.4); length of caudal, measured below 25.8 to 31.3 (28.8); length of claspers of males 3.3 to 6.2 (4.6); interval between pectorals and pelvics 11.5 to 19.8 (16.4); interval between first and second dorsal 6.6 to 9.4 (8.1).

The color in life is a uniform rich brown, with black edges on the fins.

Four egg cases of this species are at hand: one collected on the east side of Camano Island, July 23, 1933, in about 45 fathoms; two taken from a female 452 mm. long, which was collected August 24, 1933, in the same locality; and one egg case which was given to us by Mr. Lawrence Townsend, who collected it aboard the "Audrey" May 2, 1933. The first and last specimens were each securely attached by their tendrils to the stalk of a sea whip, *Stylatula*. The two taken from the female were perfectly formed except for the anterior tendrils. The egg case is small and shaped much like a compressed vase, with a truncate anterior end and a constricted "neck" from which the lateral edges expand posteriorly and then gradually contract to a blunt posterior point. Along each lateral edge there is a projecting ridge which runs the entire length of the case and bears on each end a long coiled tendril. These tendrils are of about the same length anteriorly and posteriorly, one measuring 365 mm. in length when straightened out. They taper gradually to a thin distal end. The egg case is brownish and translucent so that the single white egg can be easily seen in it. The least length (not including the tendrils) ranges from 52 to 56 mm., average 53.8; the greatest width varies from 22 to 25 mm., average 23.2; and the least width (at the anterior constriction) ranges from 14 to 17 mm., average 16.5. The case is constricted dorsoventrally so that its greatest depth is only a little more than half the greatest width.

Squalus suckleyi (Girard)

Squalus suckleyi is an ovoviviparous shark. The eggs, as normally in elasmobranchs, are deposited in the Mullerian ducts enclosed in an egg case, in which the embryos begin their development. When the embryos have developed to a size which is not exactly known, the egg case is either resorbed or sloughed off. The embryos then continue their development in the Mullerian duct, which is abundantly supplied with large blood vessels and has, dependent from the inner side, innumerable small platelets which are also liberally supplied with blood vessels. When the yolk has been completely absorbed, the young dogfish are born alive. The longest embryo we have taken from the 8 egg cases examined was 20 mm. long.

The long and tubular egg case is transparent, flexible, entirely smooth, and ends anteriorly in a single elongate horn bearing a tendril which in one specimen was 70 mm. long. Posteriorly the egg case is truncate and bears two short horns laterally which terminate in a short tendril. A 170 mm. egg case (measured without tendrils) contained 3 eggs, although the number

varied from 1 to 4 eggs in others. The egg is tough in life but in the preserved specimens is very easily ruptured. The yolk of six eggs to which were attached embryos 14 to 15 mm. long, displaced from 38 to 43 cc. each. The yolk of five others, with 20 mm. embryos, displaced from 31 to 36.5 cc. In each of the 4 females in which egg cases were found, and in numerous specimens examined containing larger embryos, equally developed embryos were always found in both Mullerian ducts. Embryos were not always present in equal numbers in each duct of a female. The sex ratio of embryos within the two ducts was not always the same.

Raja rhina Jordan and Gilbert

Egg cases of *Raja rhina* have been taken abundantly off Everett by the "Audrey", and a few have been secured from the San Juan Islands. They are rectangular and bear at each corner a short and slender horn, the anterior pair of which are the longest. The lateral edges of the egg case are convex; the anterior edge, between the horns, is concave, and the posterior edge is nearly straight. At the right and left sides near the middle of each lateral edge of the egg case, a mass of long threads is attached. These bunches of threads serve to anchor the egg case to objects on the bottom. It is often found that the masses of threads have been completely worn off from the old egg cases.

The least length measured along the longitudinal axis varies from 94 to 130 mm., average 107.5 mm., and the greatest width varies from 59 to 77 mm., average 68.0 mm. These ranges and means are based on the measurements of 41 egg cases.

The egg case of *Raja rhina* contains one egg.

Those egg cases from which the young had not escaped were opened and the size of the young and the volume of yolk remaining were measured. One egg, on which the embryo had not yet started to develop, had a volume of 19 cc. Other eggs bearing embryos 34, 63, and 74 mm. in total length had 14, 12.5 and 10 cc. of yolk, respectively. In our material the largest young skate still within the egg case was 160 mm. in total length and had 2 cc. of yolk remaining. Another specimen 148 mm. long had 1.5 cc. of yolk. Since we have taken yolkless, freeliving specimens as small as 160 mm., it is evident that the size of the young when they escape from the egg case is subject to considerable variation. Probably the majority of the young escape from the egg case at a size between 150 and 170 mm. The young skate escapes through the posterior end of the case.

Raja binoculata Girard

Among the San Juan Islands egg cases of *R. binoculata* may be collected throughout the summer. In early June egg cases containing well advanced young are frequently taken, while in August freshly deposited egg cases are not uncommon. The period of incubation is unknown but since some of the eggs of the larger English skates require as many as 15 months for incubation[3], it is likely that the young of *R. binoculata* live within their egg case for the greater part of a year at least.

The egg case is rectangular, and bears a horn at each corner. All four

[3] Clark, R. S. Jour. Mar. Biol. Ass., 1922 (12): 577–643.

horns are short and broad. The posterior horns are longer than the anterior ones. As in *R. rhina*, the posterior margin of the case is nearly flat and the anterior end is slightly concave. A mass of attachment fibers is present on the anterior end of the case only. *Raja binoculata* has one of the largest if not the very largest egg case of any species in the genus. The total lengths of twenty egg cases ranged from 265 to 305 mm.; the least width from 110 to 140 mm. From 2 to 7 eggs, usually 3 or 4, are found in a single egg case of *Raja binoculata*. In this respect *R. binoculata* differs from most other members of the group, for the majority of the rays and skates have only one egg in a case.

Two young skates, measured shortly after they had hatched from an egg case in an aquarium, were 194 and 197 mm. in total length respectively.

Tetranarce californica (Ayres)

A single female electric ray 820 mm. long was taken August 24, 1933, on the east side of Camano Island in about 50 fathoms of water (Cat. No. 2898, Collection of Fishes, University of Washington). The bottom was hard clay and mud. Another female 875 mm. long, captured by the schooner "Unimak" 300 miles northwest of Cape Flattery on October 14, 1925 (Cat. No. 2899, Collection of Fishes, University of Washington), was recorded by D. R. Crawford[4]. These specimens differ in many respects from the original description of the species by Ayres[5]. If the variation in body proportions is truly as great as it appears, it may lead to the identification of the Pacific species with *Torpedo nobiliana* Duméril of the Atlantic. At present these specimens can only be referred to *Tetranarce californica* (Ayres).

Various body proportions are given below in hundredths of the total length. The first figures are those for the specimen caught off Cape Flattery, and next are those for the Camano Island specimen. The figures in parenthesis are Ayres' measurements converted into hundredths of standard length. Greatest width of disk 64.0, 52.5 (68.3); width of disk at insertion of ventrals 50.2, 40.8; greatest length of disk 54.2, 47.3 (56.3); distance between the lateral origins of the ventrals 22.8, 19.2; width of body at the posterior end of the ventrals 7.1, 5.2 (8.5); depth of caudal peduncle 3.0, 2.2; length of snout 7.5, 5.7 (6.1); snout to spiracle 11.7, 8.5; snout to first dorsal 63.0, 48.8; snout to second dorsal 73.7, 57.6; snout to origin of caudal 85.1, 66.0; snout to first gill opening (measured on the median axis) 18.8, 15.9; snout to vent 57.7, 46.0; snout to origin of ventrals (measured on the median axis) 49.8, 41.3; snout to upper jaw 6.8, 6.5; interorbital space (measured from iris to iris) 7.5, 6.0 (11.0); longest diameter of the eye 1.1, 1.8 (1.5); longest diameter of the spiracle 3.1, 2.4 (2.4); height of first dorsal 9.0, 7.3 (10.5); height of second dorsal 6.5, 4.3 (6.4); length of base of first dorsal 6.6, 4.1 (6.7); length of ventral fin base 21.1, 14.9; greatest length of ventrals 25.1, 12.8; posterior insertion of ventrals to origin of caudal 17.5, 14.3; greatest height of caudal 22.3, 17.0; width of mouth 10.6, 5.7 (7.3).

The anterior outline is nearly straight across the snout, rounding off evenly at the sides. It is not emarginate. All the fins are evenly rounded so that no sharp corners are apparent on the fish. The ventrals are inserted

[4] COPEIA, 160, 1927: 182.
[5] Proc. Cal. Acad. Sci., 1, 1855: 70–71

slightly ahead of the posterior margin of the disk. The caudal fin is large, truncate, and triangular. The anterodorsal edge is slightly longer than the anteroventral edge. The greatest height of the fin is about one-fourth greater than the length of the anterodorsal edge.

The eyes are small and elliptical. The skin of the interorbital space is coextensive with that on the mesial side of the eye so that it is not possible to tell without dissection the exact mesial limits of the eyeball. The spiracles are likewise elliptical and are placed anterolaterally and posteromesially directly behind the eye, at a distance of one-half to two-thirds the anteroposterior diameter of the eye. The edges are not filamentous but within, on the anterior edge, are twelve or thirteen rudimentary gill filaments that appear as rounded tubercles.

The electric organ of the Camano Island specimen was examined. It is placed laterally on the anterior portion of the disk, extending anteriorly three-fourths of the length of the snout past the eye, and posteriorly to a distance (measured on the median axis) of 230 mm. from the tip of the snout. Opposite the eye it attains its greatest width, which is 89 mm. At the middle of the length of the organ it is 87 mm. wide. Anteriorly it is bluntly rounded; posteriorly it tapers to a blunt point. Its overall length is 218 mm. In the organ of the right side, between 700 and 750 vertical cells are apparent on the dorsal side. Although the fish was kept alive on board the boat for eight hours after its capture, and was freely handled at intervals during that time, no shock from its organ was felt either at the time of capture or during the day. The color in life was bluish gray above and whitish below, with black spots scattered over the skin, freely above but sparsely below. Since preservation in formalin the specimen has become darker, especially where the mucous has been rubbed off. Just after capture, when the fish was placed in a tub of fresh sea water, it sloughed off mucous copiously, not as a slime, but in patches of varying sizes. It repeated this process at intervals during the day whenever fresh sea water was added to the tub.

Hydrolagus colliei (Lay and Bennett)

Many egg cases of the ratfish have been taken by the "Audrey." The lengths of 63 cases range from 114 to 140 mm., average 125.8, and the widths ranged from 19 to 24 mm., average 21.1. A tendril 120 mm. long was seen on one freshly deposited egg case. Invariably the egg cases were found to be empty or to contain undeveloped eggs. Not one embryo has been found. In one instance the trawl brought up a female ratfish to which the egg cases were still attached by their long anterior filament. Dean[6] mentions the same phenomenon in his extensive treatise on the egg cases, eggs, and larval development of *H. colliei* off the California coast.

Measurements of the volume of the yolks from 30 ratfish egg cases gave the average of 4.85 cc. for each yolk.

DEPARTMENT OF FISHERIES, UNIVERSITY OF WASHINGTON, SEATTLE, WASHINGTON.

[6] Publ. Carn. Inst. Wash., 32, 1906: 1–195.

Histological Changes in the Prolapsed Intestine of a Fish, *Mollienisia latipinna* Le Sueur

By Ross F. Nigrelli and C. M. Breder, Jr.

THE behavior in vitro of the endodermal cells of vertebrate intestine has been studied by various workers. Fischer (1922) was able to cultivate fragments of small intestine from a 21 day old chick embryo. In such small pieces he found that the epithelium proliferated and completely covered the fragment of intestine after four to six days. When grown in a medium containing plasma and tissue juices, a small round body was formed, surrounded by cylindrical epithelium and containing epithelial, connective and muscle tissue, endothelium, and amoeboid cells. On the other hand, when these masses were cultivated in the embryo juices without plasma, the intestinal villi remained normal while the stroma, connective tissue cells and their fibrillae progressively disappeared, leaving an epithelial cyst.

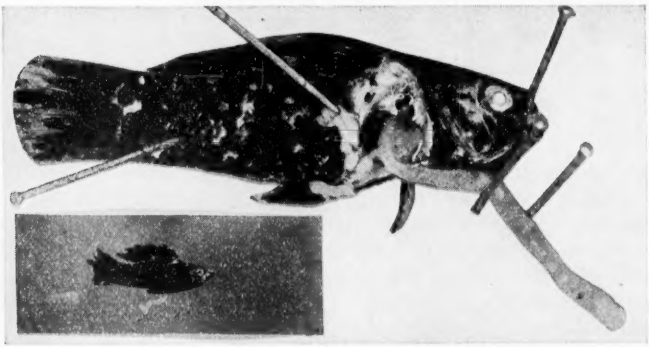


Fig. 1. The autopsied fish showing the relationships of the abnormal intestine. Explanatory letters are given for Figure 2, which is a tracing of this photograph. Enlarged about four times. The lower left-hand insert is a photograph of the live *Mollienisia* with the protruding intestine before it was ligated. This is seen as a white cord depending from the anus.

According to Lewis and Lewis (1924) in Locke-bouillon-dextrose medium the cells from the stomach and intestine of chick embryos maintain their epithelial character for many days and show little or no differentiation. In older cultures degeneration granules and vacuoles are present in many of the cells. Owing chiefly to the physiological difficulties involved, the study of histological changes of a comparable sort *in situ* is impractical, except for periods too short for important cellular modifications to occur. The ligation of a fully differentiated intestine brings with it such profound physiological changes that rapid death of the organism is often the result.

The present communication concerns the histological appearance of a portion of the intestine which had been exposed to the external environment; *i. e.*, the aquarium water, for a considerable time. This condition arose spontaneously and involved the complete separation of the digestive tract into an anterior and posterior part with the eversion of the isolated posterior segment through the anus.

The laboratory of the New York Aquarium received a living male *Mollienisia latipinna* Le Sueur, from the anus of which protruded a portion of the intestine. This apparently normal specimen had been in the private collection of Mr. Howard Dixon, of the Aquarium staff, and the owner was able to watch the beginning and progressive protrusion of the gut. According to him this took a period of some three months to reach the size displayed when brought to the Aquarium. During this period the fish continued feeding and persistently attempted to mate.[1] Occasionally the dependent portion of intestine would catch on plants in the aquarium, causing some inconvenience until it was freed.

The living fish was photographed when first received. This (Fig. 1, insert) shows the appearance of the protruding organ, and indicates the general healthy appearance of the animal. It was kept under observation for two weeks. At the end of this time, in order to determine whether the protruding part possessed a lumen, a ligature of fine silk was placed near the end and the terminal quarter-inch removed. A few days later the fish was killed.

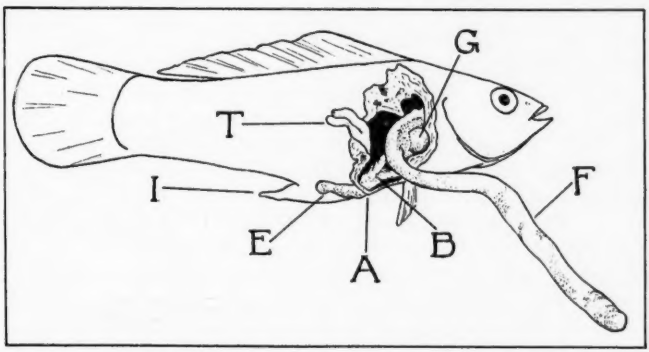


Fig. 2. Line drawing of the autopsied fish in Figure 1.
A—anus; B—part of intestine just inside of the anus; E—prolapsed part of the gut; F—the intestine filled with gelatine, showing the blind ending; G—gall-bladder; I—gonopodium; T—testes.

The writers are indebted to Dr. A. B. Dawson of the Biological Laboratories, Harvard University, for his critical examination of both manuscript and material.

Morphology and Histology of the Abnormal Intestine

A post-mortem examination revealed that the prolapsed element was actually an everted part of the digestive tract and ended blindly. The striking abnormalities of its gross anatomy are indicated in Figs. 1 and 2. The esophagus and the stomach, a negligible swelling in this species, were normal. The anterior portion of the intestine, for a distance nearly equal to the length of the fish, presented a characteristic appearance, but terminated abruptly in a blind and rounded end. In the illustration this part is turned forward (Fig. 2, F). The protruding gut (Fig. 2, E) was found to pass through the

[1] *Mollienisia latipinna* Le Sueur is valued by home aquarists as an ornamental fish, especially the melanistic phase of which the present individual is a representative. With the exception of the protruding intestine there was nothing unusual in the external anatomy of this specimen. The species is ovoviviparous, and the males are persistently in their efforts to effect internal fertilization.

anus and into the body cavity where it bifurcated and then split up into a brush-like end of fine, blind tubules (Fig. 2, B). Thus there was no continuous lumen from mouth to anus, although the viscera were suspended by the usual mesenteries. A suspension of carmine was introduced by hypodermic syringe into both the anterior and posterior portions. A considerable pressure thus built up showed no openings. It should be mentioned in passing that the other organs, such as liver, spleen, and gonads presented a strictly normal appearance.

The prolapsed gut, and that part just inside the anus were removed, fixed in Bouin's fluid, sectioned, and stained with Delafield's hematoxylin. For purposes of comparison a section of the intestine was taken from a normal individual of the same species (Fig. 3). Histologically it is typical of the vertebrate intestine. The abnormal gut, however, showed definite histological changes, some of which represent degeneration and some transformation with proliferation.

As would be suspected the prolapsed gut, although blind at both ends, was turned inside out. The general appearance of the portion just inside the anus is shown in Figs. 4 and 5. Theoretically this should appear as a double-walled structure with the two mucosal surfaces apposed. Apparently only the inner portion remained. In the sections studied the mucosa was on the outside, while the serosa lined the new lumen. The intestinal epithelium was completely sloughed off leaving the naked connective tissue plicae extending outward as a fringe. The connective tissue of the sub-mucosa showed remarkably little change. Infiltration with round cells was at a minimum. The circular and longitudinal muscle layers persisted almost intact. The cells showed some shrinkage with vacuolation.

The greatest changes were exhibited by the serosa. In many places the mesothelium was interrupted by an intense proliferation of submesothelial fibroblasts which invaded the new lumen and almost occluded it. The fibroblasts tended to be arranged in cords, the centers of which were usually occupied by small arteries. This fibroblastic proliferation was probably responsible for the closing of both ends of the everted gut. Clusters of densely staining cells were found in the fibroblastic cords. They have not been identified with certainty, but have been interpreted as massed macrophages.

The protruding part of the gut, however, differed in appearance from the portion internal to the anus. In this region the intestine was also inside out with the epithelial cells of the mucosa covering the external surface, and

---

Explanation of Figs. 3 to 8

Photomicrographs of sections of normal and abnormal intestine, stained with Delafield's hematoxylin and eosin.

Fig. 3. Cross section of normal intestine.

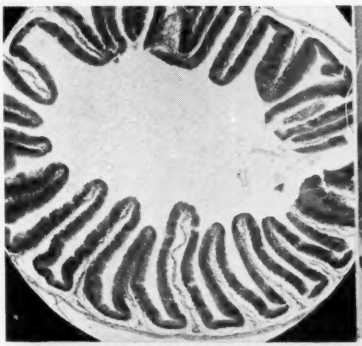
Fig. 4. Cross section of the part just internal to the anus showing the reversal of position of the layers of the intestinal wall. The epithelium is absent and the new lumen filled with connective tissues containing many phagocytes.

Fig. 5. Higher magnification of Fig. 4.

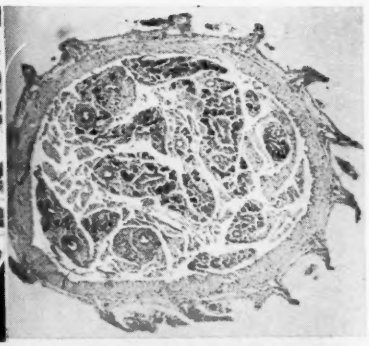
Fig. 6. Cross section of the protruding gut. Position of the layers as in Fig. 5. Note the persistence of the intestinal epithelium.

Fig. 7. Higher magnification of a peripheral area of Fig. 6, showing the epithelium, infiltrated tunica propria and submucosa, circular muscle layer, disrupted longitudinal muscle layer and fibroblastic proliferation from the serosa.

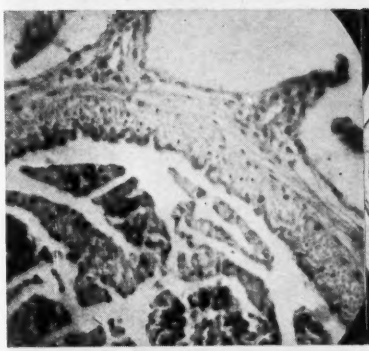
Fig. 8. Higher magnification of a peripheral area of Fig. 7, showing epithelial invasion of the submucosa with cyst formation.



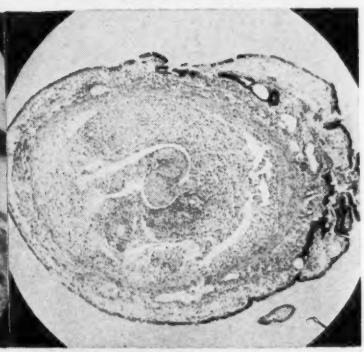
3



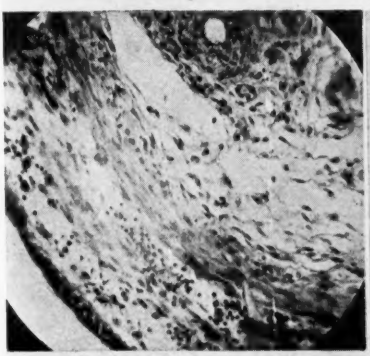
4



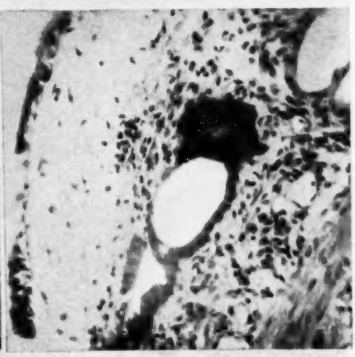
5



6



7



8

Figs. 3 to 8. See legend on p. 70, opposite.

in contact with the water (Fig. 6). The epithelial layer appeared to be maintained almost intact. The submucosa was thickened and the plicae were no longer present. There was a marked infiltration of the connective tissue with some evidence of edema. The circular muscle layer had a normal appearance in some regions, while in others it was partially disrupted by fibroblastic invasion. A much greater disturbance of the muscle fibres was observed in the longitudinal coat. In the serosa fibroblastic proliferation was still more marked. The mesothelium had disappeared and the new lumen of the inverted gut was practically filled with a loose connective tissue of varying density. In many regions apparently normal nerve cells of the myenteric plexus were observed. This external portion of the intestine was well vascularized, but in some areas the capillaries had broken down and the blood was accumulated in sinus-like spaces of the loose connective tissue (Fig. 7).

Most of the changes just described, with the exception of those occurring in the epithelium, are characteristic of a mild inflammatory reaction. As already noted the epithelium persisted as a complete covering even though exposed to an abnormal environment. Moreover, considerable mitotic activity was observed and solid epithelial cords had invaded the thickened submucosa. In many instances the cells had accumulated to form large masses deep in the connective tissue. Typical intraepithelial cysts were present in some of the larger cell aggregates (Fig. 8).

Discussion

It is remarkable that this fish with such an abnormal intestinal tract should have been able to maintain its usual activities, especially feeding. No clear explanation of the manner of functioning of the digestive tract can be given. It would seem that regurgitation of the materials destined to become faeces must have taken place.

The cellular changes displayed by the epithelium of the protruding portion of the gut are the most interesting. The exposure to an abnormal external environment would lead one to expect extensive degenerative changes. On the contrary there was extensive proliferation with migration into the underlying tissues.

It is believed that the persistent epithelium of the outer surface of the prolapsed gut represents the original intestinal lining. It must be borne in mind, however, that at the rim of the anus the epithelium of the epidermis and the digestive tract are continuous. There is, therefore, a possibility that the original epithelium in the present instance had been sloughed off and that a new epithelium, derived from the epidermis, had migrated out over the surface of the denuded intestine. The epithelium of the external segment of the gut, however, was a simple columnar, and had the appearance of a slightly dedifferentiated digestive epithelium lacking goblet cells. Accordingly the possibility of a derivation from epidermal epithelium seems rather remote.

A somewhat similar condition was described by Labbé (1929) in the marine fish *Merlangus merlangus* Linnaeus = *Merluccius merluccius* (Linnaeus). In this fish the intestine was divided into two distinct parts (but not prolapsed) and showed islet formation of the epithelial cells within the lumen. He found cylindrical, oval and spherical cells with pycnotic nuclei. The

longitudinal muscle was hypertrophied and characterized by the separation of its fibers. Labbé further described an infiltration of phagocytes, and the presence of other cells with degeneration granules. He also found definite blood lacunae in which the hematic and endothelial cells were degenerated.

Summary

1. A fish, *Mollienisia latipinna* Le Sueur, lived for three months with the posterior portion of the gut prolapsed and isolated anatomically from the anterior portion.

2. Two regions of the prolapsed gut are considered: the part just internal to the anus and the protruding part, external to the anus. In both regions the anatomical relationships of the several layers are reversed, the mucosa being on the outside, with the serosa lining the new lumen. Within the anus the epithelium had disappeared, whereas on the portion exposed to the water the epithelium persisted, giving striking evidences of proliferative activity. In many instances ingrowths into the underlying loose connective tissue occurred, forming solid cords or large epithelial masses. The muscle layers were not greatly modified. In the submucosa, and more especially in the serosa, there was an extensive fibroblastic proliferation. The loose connective tissue derived from the serosa almost occluded the lumen and blocked both ends of the gut.

3. The most striking feature of this intestinal abnormality is the persistence and proliferative activity of the intestinal epithelium under an adverse and abnormal environment.

References

Labbé, A.
1929 Tumeur complexe avec scission de l'intestine chez un Merlan (*Merlangus merlangus* L.). *Compt. Rend. Soc. Biol.*, 102: 312–313.

Lewis, W. H., and Lewis, M. R.
1921 Behavior of cells in tissue cultures. Section VII of General Cytology. E. V. Cowdry, Editor. 754 pp.

Fischer, A.
1922 Cultures of organized tissues. *Jour. Exp. Med.*, 36: 393–397.

Department of Biology, New York University, and New York Aquarium, New York City.

Two New Species of *Triturus* from California

By Victor C. Twitty

My interest in the taxonomy of this genus in California was first stimulated in April, 1934, by the discovery that *Triturus* embryos collected for experimental purposes near Ukiah, Mendocino County, differed strikingly in their development from those of *torosus* (Rathke), familiar to me from collections near Stanford, and described in accounts by Ritter (1897) and Storer (1925). As a result of subsequent observations and extensive collecting it has been possible to distinguish two new forms, here described as species, of this common western salamander. The present account is limited to a description of the salient features of the life-history necessary to establish these forms as distinct. The bulk of the data concerning the life-histories, development and relationships in nature of the three forms of California *Triturus* (including *torosus*) will be presented later.

Triturus ***rivularis,*** new species

Type specimens deposited in the Museum of Vertebrate Zoology, Berkeley, California. Holotype: No. 18131; paratypes: Nos. 18132–40. Collected by writer, at Gibson Creek, about one mile west of Ukiah, California, on February 22, 1935. Additional paratypes, Nos. 18141–48, collected at same place by writer, December 29, 1934.

Diagnosis of Adults.—Head narrower than in *torosus,* pointed; eyes prominent, *dark-brown* (black to casual examination), in contrast to the yellow eyes of *torosus;* back and sides black, occasionally brownish in breeding males; *tomato red below,* as opposed to yellow or orange in *torosus;* transverse black band across cloaca of males, presence variable in females; two rows of palatine teeth parallel and close together anteriorly, divergent posteriorly (for comparisons with other *Triturus* see fig. 2). Measurements of several individuals are given in Table 1.

Distribution.—Adults were first collected November 12, 1934, about one-half mile west of Ukiah, Mendocino County, California, in or near a small mountain brook known locally as Gibson Creek, and inhabited by *Dicamptodon* larvae and small trout. Eggs were first found in the preceding April, of the same year, in a mountain stream at Orr's Springs, 14 miles northwest of Ukiah. Subsequently the known range has been extended to include several remote points in Mendocino County, from north of Ukiah to south of Hopland, always in or near mountain streams, mostly tributaries of the Russian River. Within this region the species is very abundantly represented. We have not yet had opportunity to check its distribution beyond these limits.

Life-History.—To my knowledge breeding occurs only in streams of typical mountain-brook character, where the eggs are attached in secure clusters to the ventral or overhanging surfaces of stones, often in the middle of the stream in very swift water. In only two or three very exceptional instances were they found attached to submerged roots at the side of the stream, after the manner of *torosus*. Great numbers of breeding adults and

several hundred egg clusters were collected or observed at Gibson Creek and Robinson Creek, near Ukiah, in April, 1935. Active spawning in these streams was apparently confined to approximately the first three weeks of April, with the peak near the beginning of the month.

The skin of breeding males is almost completely smooth. As compared with males of other California *Triturus* in breeding condition, the dorsal tail-fin is less prominent, and the cloacal lips less enlarged. The tendency for the male to "saddle" the female with the cloacal lips is not as pronounced as in *torosus* and *similans* (see below). Males brought into the laboratory were found to have deposited spermatophores over night. This act apparently followed a preliminary courtship, in which I observed the male, with arms clasped around the female from above, to rub his cloaca over her back by an active lateral motion of the body and tail. To my knowledge the deposition of spermatophores has not been observed in other California *Triturus*, in which the manner of embrace suggests the probability of a direct transfer of spermatozoa.

TABLE I

Measurements (in mm.) of adults of *T. rivularis* (carefully preserved formalin specimens) collected at Gibson Creek, near Ukiah, California.

Date collected	Sex	Total length	Tail length	Tip of snout to gular fold	Greatest width of head	Eye to external naris	Interorbital distance
2/22/35	*♂	183	103	19.0	16.0	6.0	6.0
"	♂	185	106	19.0	16.0	6.0	5.5
"	♂	185	103	20.0	17.0	6.0	6.0
"	♂	185	103	20.0	16.0	5.0	5.2
"	♂	170	100	19.0	15.0	5.5	5.5
"	♂	185	105	20.0	16.0	5.5	5.5
"	♂	180	104	19.0	15.5	6.0	6.5
"	♂	183	104	20.0	16.0	6.0	5.5
"	♂	175	100	19.0	16.0	5.5	6.0
"	♂	165	93	18.0	14.0	5.5	5.5
12/29/34	♀	173	96	20.0	15.0	5.0	6.0
"	♀	154	79	19.0	15.0	5.5	6.0
"	♀	158	88	18.0	14.0	5.5	5.5
"	♀	163	87	19.0	15.0	5.5	6.0
"	♀	145	75	17.0	15.0	5.0	5.0
"	♂	150	82	17.5	14.5	4.5	5.5
"	♂	157	90	18.0	15.0	4.5	5.0

* Holotype.

EGGS.—The egg clusters are readily distinguished from those of *torosus*. They are flattened instead of round, with the eggs often forming only one layer; there are fewer eggs per cluster (average of 9 for 20 clusters counted, with extremes of 5 and 15); and the individual eggs are considerably larger. Thirty-two eggs in the blastula stage averaged about 2.75 mm. in diameter as compared with about 2.25 mm. for *torosus*. Pigmentation of the eggs is variable, generally dark gray or grayish brown. Completely albino eggs are not uncommonly found. These develop into larvae with normal pigmentation. Eggs are deposited in great abundance. In one case where a count

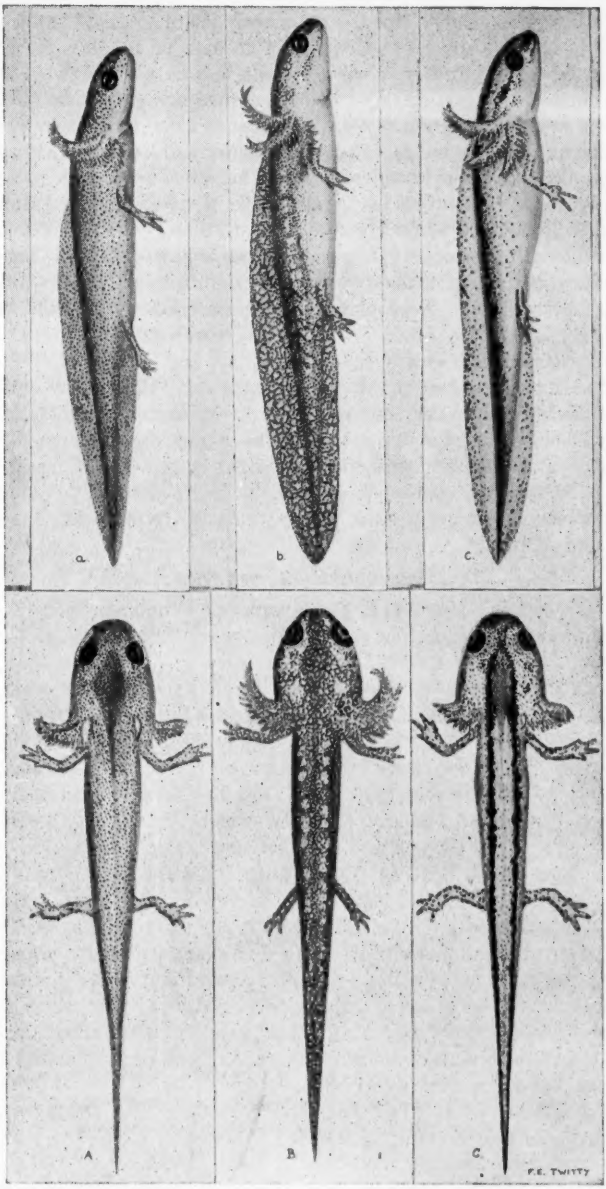


Fig. 1. Larvae of *T. rivularis* (A, a); *T. similans* (B, b); and *T. torosus* (C, c). Scale drawings from photographs of living specimens measuring about 25 mm. in length. In older specimens of *rivularis* the color becomes a denser brown, and the dorsal fin extends anteriorly to a point approximately mid-way between fore and hind limbs. Older larvae of *similans* also become more heavily pigmented, their color suggesting a dull olive green.

was made, approximately 70 egg masses were found attached to the ventral surface of a single stone, crowded within an area of 12×8½ inches.

LARVAE.—The balancer, always present in *torosus*, is either absent or very rudimentary, never attaining half the normal size of *torosus*. The dorsal fin is less prominent than in *torosus*, and extends much less further anteriorly on the trunk (fig. 1, a and c). The head is flatter and longer (fig. 1, a and c). Pigmentation is strikingly different from that of *torosus*, with no trace of the dorsolateral pigment bands at any stage of development. Instead, the pigment is distributed uniformly over back and sides. The larval eye, unlike that of the adult, possesses yellow pigment, as in *torosus* larvae. The length at metamorphosis is approximately the same as in *torosus* (about 45–55 mm., in few measurements available). At metamorphosis the skin becomes roughened, as in all California *Triturus*, by dermal papillae.

This salamander is clearly the most unusual and specialized of the three California representatives of the genus. Particularly noteworthy are certain larval features, such as the reduction of the dorsal fin and loss of the balancer, said by Noble (Biology of the Amphibia) to characterize the larvae of mountain-brook amphibians in general. It was this suggestion of marked commitment to the mountain-brook habitat, including the habit of depositing the eggs beneath stones in swift water, which led me to select the species name here adopted.

Triturus ***similans,*** new species

Type specimens deposited in the Museum of Vertebrate Zoology, Berkeley, California. Holotype: No. 18149; paratypes: Nos. 18150–77. Collected by writer, at Robinson Creek, Ukiah, California, on April 20, 1935.

DIAGNOSIS OF ADULTS.—Superficially the adults are easily confused with those of *torosus*. Readily diagnostic as a rule are the palatine teeth, the two rows of which tend to diverge gradually, to suggest the letter V (for comparison with other *Triturus* see fig. 2). Breeding females are immediately distinguished by the form of the cloaca. The lips form a conical elevation, somewhat compressed laterally, with the opening at the apex, whereas in *torosus* and *rivularis* the aperture is longer, and lies in a depression between the prominent lateral lips (fig. 3). In large males the head is considerably broader in proportion to its length than in *rivularis*; the same is true as a rule in comparison with *torosus* (see tables 1, 2, and 3; and fig. 4). One will note further that the interorbital distance is characteristically greater than the length of the muzzle in this sex, unlike *torosus* and *rivularis* males. The dorsal tail fin in large breeding males is developed to a height which we have never observed in other California *Triturus* (see, e.g., fig. 5), but this difference requires further comparative study. Color is in general similar to that in *torosus*, but appears more variable.

DISTRIBUTION.—First identified from collections at a small permanent spring-fed pool near Saratoga, California, November, 1934. Later found at other points near Saratoga, and also in great abundance at Ukiah. Now believed to be widely distributed in northern California.

LIFE-HISTORY.—The limits of the breeding season remain to be established. Eggs of this species were first discovered in nature near Saratoga on February 25, 1935, but my observations indicate that the peak of the

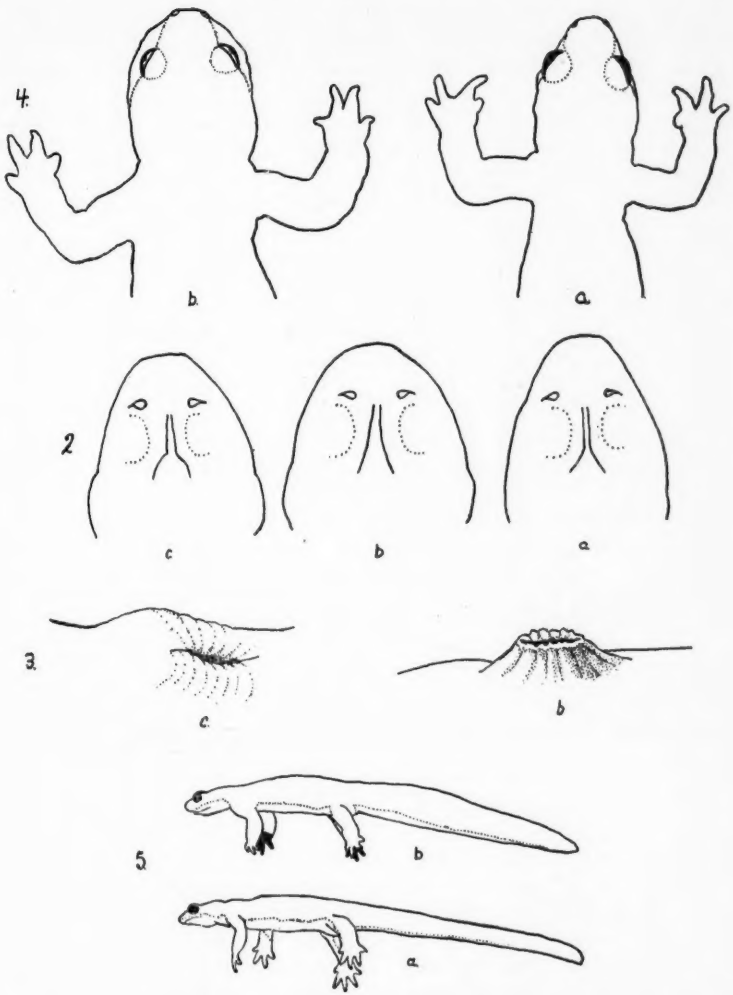


Fig. 2. Outline drawings showing the typical arrangement of the two rows of palatine teeth in *T. rivularis*, a; *T. similans*, b; and *T. torosus*, c. Traced from photographs of the roof of the mouth of freshly decapitated adults.

Fig. 3. Drawings from photographs of the female cloaca of *T. similans*, b; and *T. torosus*, c. The cloaca of female *rivularis* is similar to that of *torosus*.

Fig. 4. Outline tracings from photographs, showing head shape in males of *T. rivularis*, a; and *T. similans*, b.

Fig. 5. Outline tracings from photographs of males in active breeding condition: a, *T. rivularis*; b, *T. similans*, showing the greater height of the tail-fin in the latter. The dark pigmentation of the palm often developed in males of *similans* has never been observed in *rivularis*. The difference in the pigmentation of the eye is also indicated.

TABLE II

Measurements (in mm.) of adults of *T. similans* (carefully preserved formalin specimens) collected about 4 miles southwest of Ukiah, California, April 20, 1935.

Date collected	Sex	Total length	Tail length	Tip of snout to gular fold	Greatest width of head	Eye to external naris	Interorbital distance
4/20/35	♂	190	105	19.5	19.0	5.5	7.0
"	*♂	195	113	21.0	19.0	5.5	7.5
"	♂	205	114	19.0	19.0	5.0	7.5
"	♂	180	96	19.5	18.0	5.5	7.0
"	♂	195	112	19.0	19.0	5.0	6.5
"	♂	210	126	20.0	19.0	5.0	7.0
"	♂	165	90	16.0	16.0	4.5	5.5
"	♂	183	107	19.0	17.0	5.0	7.5
"	♂	187	113	18.0	17.0	5.0	7.0
"	♀	147	76	18.0	15.0	4.5	6.0
"	♀	160	87	17.5	15.5	4.0	5.0
"	♀	148	80	17.0	16.0	4.0	6.0
"	♀	153	86	16.0	15.5	4.5	5.5
"	♀	146	78	16.0	15.0	4.5	5.0
"	♀	173	98	18.0	17.0	6.0	6.0
"	♀	160	86	18.0	16.5	5.0	6.0
"	♀	135	69	17.0	14.5	5.0	5.0
"	♀	138	72	14.0	14.0	5.0	5.0
"	♀	163	90	18.0	16.0	5.0	5.5

* Holotype.

TABLE III

Measurements (in mm.) of adults of *T. torosus* (carefully preserved formalin specimens). Included for comparison with measurements of two new species described herein. Those from Ukiah were collected at time of spawning in a municipal water-reservoir about 4 miles southeast of Ukiah. The specimens from Stanford were collected at time of spawning in a small creek on Portola Road, 4 miles from the University.

Date collected	Sex	Total length	Tail length	Tip of snout to gular fold	Greatest width of head	Eye to external naris	Interorbital distance
12/28/34*	♂	188	105	19.0	18.0	6.0	6.0
"	♂	195	106	20.0	19.0	5.0	5.0
"	♂	180	96	21.0	19.0	5.0	5.0
"	♀	155	80	18.0	17.0	5.0	5.0
"	♀	177	90	20.0	19.0	6.0	5.0
"	♀	160	77	20.0	17.0	5.0	5.0
"	♀	175	93	20.0	18.0	5.5	5.0
"	♀	155	78	19.0	16.0	5.0	5.0
"	♀	170	88	21.0	18.0	6.0	6.0
2/28/35	♂	165	88	19.0	16.0	5.0	5.0
"	♀	145	72	17.5	16.0	5.0	5.0
"	♀	147	76	17.5	15.5	4.0	5.0
"	♂	172	94	21.0	17.0	6.0	6.0
"	♀	153	80	17.5	15.0	5.0	5.0
"	♀	145	73	17.5	15.0	5.0	5.0
"	♂	167	88	19.0	16.0	6.0	5.0
"	♂	163	85	18.0	16.0	5.0	5.0

* Collections under this date were made at Ukiah, California, and those under 2/28/35 at Stanford University.

breeding season came somewhat later, in early March. By this time *torosus* apparently had ceased breeding in the vicinity. There is some evidence that *similans* may extend its breeding, perhaps intermittently, over a considerable portion of the year. This is suggested by the fact that approximately 100 larvae, ranging more or less evenly from 20 to 75 mm., were collected in November, 1934, from the pool mentioned above. Moreover, animals in a condition to breed may be found in the water during several months of the year. At Ukiah, mating animals were found in abundance on March 9, and April 20, 1935, the females with eggs in the oviducts. *T. similans* is common in both ponds and streams in this region. In the latter habitat it is often found together with *rivularis*, but I have not yet determined whether *similans* actually spawns in these streams. Adults brought back to the laboratory have deposited fertile eggs which develop into typical *similans* larvae, but as yet I have found neither eggs nor larvae of this species in the streams where the adults were collected. The *rivularis* larvae, on the other hand, may be collected in numbers there during the summer months.

The general situation at Ukiah with respect to *Triturus* is especially interesting, and will be discussed in a later publication. All three species of *Triturus* are represented there in abundance.

EGGS.—One of the striking differences from *torosus* is the habit of depositing the eggs singly.[1] I have observed the spawning behavior in laboratory aquaria, where the eggs are attached to the stems and leaves of aquatic plants, and have also collected single eggs in nature. The eggs are characteristically smaller than those of *torosus*, measuring about 1.8 mm. (in morula stage).

LARVAE.—The larvae are very readily distinguished from those of *torosus* and *rivularis* (fig. 1). At hatching they are smaller (12 mm. at the beginning of independent feeding), but may reach a greater size before metamorphosis (commonly up to 75 mm.). As in *torosus*, the balancer is always present and the dorsal fin is complete. In very young individuals, before or at the time of hatching, there is a poorly defined dorsal pigment stripe on each side; laterally, there is much more pigment over the yolk area than in *torosus*. Subsequently, the dorsal stripe becomes diffuse, and the distribution of pigment over back and sides becomes essentially uniform. There is no possibility of confusing these larvae with those of *torosus* (see fig. 1), in which the dorsal pigment band is clearly distinguishable throughout larval life. Differences in body-proportions will be studied and described later.

Choice of *similans* as the specific name for this form is partly in recognition of its general similarity in appearance in adult stages to *torosus*, with which it has undoubtedly been confused in the past. Their separation appears quite justified, however, on the basis of well-defined criteria for distinction in mature animals, and particularly the striking differences in breeding habits and larval development. It also seems clear that the name *torosus* should continue to apply to the common form whose life-history is already well-known, and established in the literature.

[1] The deposition of single eggs by *Triturus* in Oregon was reported by Chandler (Oregon Agric. Coll. Exp. Sta., Bull. 152, 1918), and it is not improbable that he was dealing with the form described here. He suggests, in fact, without further explanation, that the *Triturus* of that region might prove to differ from those elsewhere. I have as yet been unable to secure Oregon material for comparison.

The analysis of the two species described above is based on the examination of hundreds of adults, and on a large amount of larval and embryonic material collected in nature. Moreover, the larval development of each species has been observed from eggs laid in the laboratory.

ADDENDUM.—Evidence of further differentiation within the genus is to be found in material recently collected in the Santa Lucia Mountains. The differences from *torosus* are minor, but apparently constant; at present the data are not sufficient to warrant a description.

BIBLIOGRAPHY

1. RITTER, W. E.
The life history and habits of the Pacific Coast newt (*Diemyctylus torosus* Esch.). *Proc. Calif. Acad. Sci.*, ser. 3, zool., 1, 1897: 73–114.

2. STORER, T. I.
A synopsis of the Amphibia of California. *Univ. of Calif. Press*, 1925.

SCHOOL OF BIOLOGICAL SCIENCES, STANFORD UNIVERSITY, CALIFORNIA.

Observations on the California Lyre Snake, *Trimorphodon vandenburghi* Klauber, with Notes on the Effectiveness of its Venom

By R. B. COWLES and C. M. BOGERT

WHILE *Trimorphodon* is still to be regarded as one of the rarer snakes in southern California, an increasing number of specimens have come to light in collections. What apparently is the first record from the coastal region of Los Angeles County is a specimen from the Santa Monica Mountains a few miles northwest of Beverly Hills, brought to the University of California at Los Angeles by Mr. J. S. Martin, who had discovered "three or four" small snakes on October 1, 1934, under a boulder which he turned over while on a picnic. Apparently he discovered a brood of young lyre snakes, for the others were similar to the one captured and the specimen brought to us had only recently emerged from the egg as the umbilical groove was still present. This individual measures 205 mm. and is marked with 32 blotches on the body and 13 on the tail. The blotches are dark brown on a grey ground color.

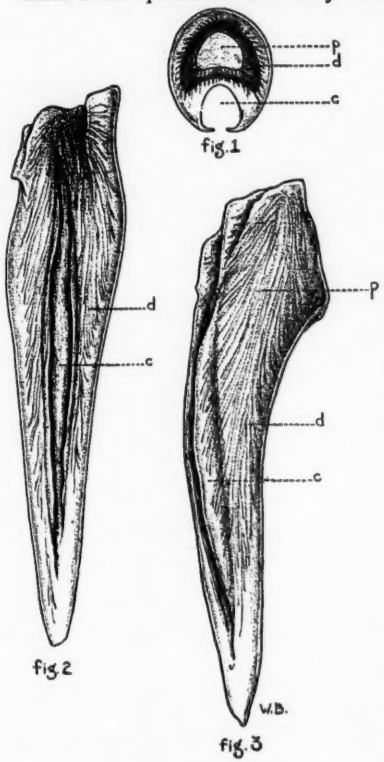
It is interesting to note that the specimen in the University of California (Los Angeles) collection, taken from Zion Canyon, Utah, is more irregularly blotched than specimens we have seen from California and has blotches on a brown ground color; other characteristics are noted as follows: Length 760 mm., scale rows 22, ventrals 229, caudals 65 pairs, anal divided, supralabials 9, infralabials 12, praeoculars 2, postoculars 3, loreals 2 with no subloreal, temporals 3+4+5, body spots 31, tail spots 13.

Klauber (1928: 186) referred to the differences between *T. lyrophanes* and *T. vandenburghi* under the following heads: anal plate, body spots and coloration, observing that there was some overlapping in all these characters. The most consistent character seems to be the anai plate which is usually divided in *lyrophanes* and entire in *vandenburghi*. Largely for this reason,

the Utah specimen has been referred to *lyrophanes*. Slevin's (1931: 140) record of *T. vandenburghi* from Death Valley suggests that the range of the two species may be continuous and eventually, when more specimens become available from intervening areas, it may be shown that *lyrophanes* and *vandenburghi* are subspecific.

The Fang of *Trimorphodon*

Since *Trimorphodon* is relatively rare in collections, the present writers were not desirous of sacrificing a specimen to attempt a dissection of the entire venom apparatus. According to Cope (1900: 1101), the posterior maxillary tooth is elongated and grooved, and this was removed for examination from the specimen of *lyrophanes* (U.C. L.A., No. 26) mentioned above. The record of this snake by Woodbury (1931: 106) was apparently overlooked in the last edition of Stejneger and Barbour (Check list, 1933) who omit Utah from their statement of its range.



The Grooved Rear Fang of *Trimorphodon lyrophanes*

Fig. 1. Transverse section, semi-diagramatic. *p*, pulp cavity; *d*, dentine; *c*, poison canal.
Fig. 2. Anterior view showing poison canal.
Fig. 3. Lateral view. The poison canal may be viewed through the transparent dentine.

Under a microscope the fang, which measures approximately 2 mm. in length, is seen to be slightly curved (see plate) with a pronounced groove extending along its anterior, convex, edge. More careful examination discloses the fact that the groove is not merely a simple groove, but that the edges curve inward tending near the proximal portion to meet, and thus form a semi-tube. When *in situ* the fang was attached to the posterior end of the maxillary bone at an angle approaching forty-five degrees.

Effects of the Venom on Other Reptiles

Apparently so little is known regarding the venomous qualities of this rare opisthoglyph snake that it has seemed worth while to attempt some experimental work on the effect of *Trimorphodon* venom.

[1] Lent to us through the kindness of Mr. R. P. Hays and Mr. H. J. Hautenbrink of Pasadena, California.

During the last year two live specimens of *Trimorphodon vandenburghi* Klauber have been available, one collected at Travertine Rock[1] in the northwest corner of Imperial County, California, and another, the previously mentioned individual, from the Santa Monica Mountains, California. The following observations are based on the specimen from Imperial County.

Klauber (1928: 190) states, concerning *T. vandenburghi,* that "the feeding is not easily observed as the snakes would only feed naturally in the dark and it was therefore necessary to leave the food in the cage. In the instances that I have observed, the snakes fed without constriction. I noted no poisoning effect upon the prey such as was seen by Duges."

The specimen we received from Travertine Rock fed readily when it was first received. On May 23, 1934, this individual, which approximated 700 mm. in length, was offered a small lizard, *Xantusia vigilis,* and it immediately showed signs of interest. After a cautious approach it seized the *Xantusia* near the middle of the body. There followed a rhythmic chewing movement of the jaws, apparently made in an attempt to bring the small rear fangs into action. Each jaw was alternately loosened and then brought down tightly, the procedure continuing for fully two minutes until the movements became slower and the snake maintained its grip on the lizard and both the snake and its prey remained motionless. At the end of approximately five minutes, the lizard, apparently quite lifeless (ostensibly from the effect of the venom), was dropped. The snake selected the head end of its prey and proceeded to engulf it in much the same fashion as do most other colubrine snakes. These observations very closely parallel those made by Dugés on *T. biscutatus*[2] and those made by Klauber on *T. vandenburghi* (1931: 72).

The Effect of *Trimorphodon* Venom on Mammals

In order to observe the effect of the venom of *Trimorphodon* on warm-blooded animals two experiments were made with the specimen used above. For comparison a third experiment was made in which a juvenile specimen of *Crotalus scutulatus* was used. Since it was obviously impossible to extract venom from *Trimorphodon* in usable quantities, the procedure followed was simply that of inducing the snake to bite the forefoot of a young white rat in the first experiment and the forefoot of an adult male white mouse in the second experiment. A similar procedure was used in the third experiment with *C. scutulatus.* No precautions for maintaining sterility were taken.

Experiment No. 1

May 20, 1934, 2:05 P.M. *Trimorphodon* induced to bite the right front foot of a young white rat. Chewing movements of the snake were noticeable as the snake was permitted to retain its grip for several seconds. Fang marks were in evidence when the foot was released and the toes of the bitten member appeared redder almost at once. A drop of blood appeared at the site of the bite. No swelling, no appreciable discoloration except on the toes was apparent at first until 2:15 when a slight swelling of the foot became noticeable. The behavior of the white rat disclosed no indubitable signs of acute discomfort, although breathing appeared to be rapid and somewhat spasmodic.

[2] La Naturaleza (Mexico) VI, 1884: 145–148. Translation in Stejneger, Ann. Rept. U.S.N.M. for 1893 (1895): 348–349.

This may have been induced by fright on the part of the rat.

2:23. Slight swelling not readily apparent. Discoloration about the same. Four periods of accelerated breathing.

2:35. Bitten limb appeared darker (purplish).

2:42. Limb evidenced swelling of approximately one-third its normal size.

5:05. Breathing still spasmodic from time to time. Swelling seemed to be slightly diminished. Rat slightly more inactive than control.

7:00. Quieter than control, but swelling and discoloration nearly or completely gone.

EXPERIMENT No. 2

May 24, 1934, 5:27 P.M. An adult male white mouse was bitten. The snake was induced to bite after not a little persuasion. The jaws finally were forced apart and the right front foot of the mouse was inserted. The mouse was held in one position in order to prevent it from jerking its foot, while the snake hung on tenaciously for two or three minutes with chewing motions similar to those displayed when it seized the lizard. When the snake loosened its grip, the mouse was liberated in a small cage where it could be easily observed. The mouse showed evident signs of pain. The foot was held off the floor of the cage and shaken from time to time. There was twitching of the leg and body.

5:30. The leg was not being used. The head was drooping, eyes partly closed. (The control was alert and active, exploring its cage.) Becoming active, the mouse turned in circles, licking the inguinal region.

5:35. Longer periods of quiet were observed. The bitten foot was somewhat swollen and discolored. Spasmodic twitching of the entire posterior portion of the body was noted, while acute local discomfort was apparent.

5:40. Little change in condition was noted. Mouse was licking foot and scrotal region. The foot and leg were badly swollen.

5:50. Seemed to be taking more interest in surroundings although still evidently in pain.

5:55. Was using foot more, although it was still discolored and swollen.

6:14. Active. Severe edema of foot and limb.

6:35. Stamped foot frequently. Appeared very nervous and active.

6:55. Considerable grooming of foot. Obviously was in great pain.

6:56. Lesion appeared on leg. (Skin perhaps bitten through by mouse.) There was considerable leaking of edematous fluid, which was licked off by the mouse.

8:05. Edema reduced. Mouse was rather normal in actions.

10:47. Leg was still slightly discolored. The edema became appreciably reduced, but was still noticeable. Leg was used about as normal.

May 25, 8:10 A.M. Leg was still somewhat swollen and discolored. Actions of mouse were approximately normal. Swelling and discoloration remained with but little change until the following day, when the mouse was killed.

EXPERIMENT No. 3

May 24, 1934, 5:48 P.M. A small rattlesnake, *C. scutulatus*, possessing but the single "button," was induced to bite an adult white mouse on the

right front foot. It bit quickly, sank both fangs into the foot and withdrew. The mouse was liberated in a small cage and showed extreme discomforture within two minutes and remained at rest in the darkest corner of the cage.

5:50. Foot discolored, the mouse remained motionless evincing no sign of nervousness as compared with the mouse bitten by the *Trimorphodon*.

5:55. Swelling not great and discoloration not great. It was reluctant to move.

6:00. Lay flat on belly, apparently having respiratory difficulties.

6:05. Increasing inactivity. Respiration became erratic and apparently more difficult.

6:06. Struggled to move.

6:06. Almost unconscious, scarcely able to move.

6:07. Showed first "death struggles."

6:08. Turned on its side. The mouse remained in that position, breathing spasmodically. Passed several drops of urine. Reacted by movement when touched on the head.

6:12. Kicked hind foot rapidly twice.

6:15. Foot but little swollen, slightly discolored. Pupil contracted.

6:16. Completely unconscious.

6:18. Occasional twitchings, breathing forced and slow.

6:21. Convulsive movements of body became more pronounced and more frequent. Voids more urine. Movements gradually cease.

6:23. No reflexes. Dead.

Dissection immediately after death showed little or no swelling of the bitten limb and only slight discoloration.

Conclusions

On each occasion when *Trimorphodon* was induced to bite, chewing movements were apparently necessary in order for the small rear fangs to be brought into action. Possibly these chewing motions also serve to stimulate the flow of the venom. While experiments made with the single live specimen are too meagre to draw certain conclusions, the effect of the venom on the rodents bitten by *Trimorphodon* would suggest that the action of the venom is chiefly hemorrhagic as indicated by the severe local edema produced, which was unaccompanied by any marked evidence of nervous symptoms. For comparison with the rattlesnakes it is unfortunate, from one standpoint, that *Crotalus scutulatus* was used in Experiment 3 since its venom is among the least typical of the North American Crotalidae. It is suggested by Githens and George (1931: 33) that the venom of the more primitive types of rattlers (such as *C. scutulatus*) has the neurotoxic element present in greater proportion than other rattlers. This seemed to be borne out in Experiment 3 where the mouse showed severe nervous and paralytic symptoms with little local effect from the bite by *C. scutulatus* and in direct contrast to the effects from the bite of *Trimorphodon vandenburghi*.

While evidently capable of killing small lizards, it would seem that *T. vandenburghi* is harmless to man, although a painful wound might be inflicted if the snake were allowed to chew. Mr. R. P. Hays, who collected the specimen used, was bitten during the process of capture as was Klauber

(1928: 190) although in neither case was the snake given the opportunity to chew and in neither case was there any ill effect.

LITERATURE CITED

COPE, E. D.
1900 The crocodilians, lizards and snakes of North America. *Rept. U. S. Nat. Mus. for 1898*: 153–1294.

GITHENS, THOMAS S., and I. D. GEORGE
1931 Comparative studies on the venoms of certain rattlesnakes. *Bull. Antiv. Inst. of Amer.*, V (2): 31–34.

KLAUBER, L. M.
1928 The *Trimorphodon* (lyre snake) of California with notes on the species of the adjacent areas. *Trans. San Diego Soc. Nat. Hist.*, 5 (11): 183–194, pl. 22–23.
1931 A statistical survey of the snakes of the southern border of California. *Zool. Soc. San Diego*, Bull. 8: 1-93.

SLEVIN, J. R.
1931 Range extensions of certain western species of reptiles and amphibians. COPEIA, 3: 140.

STEJNEGER, LEONHARD
1895 The poisonous snakes of North America. *Rept. U. S. Nat. Mus. for 1893*: 337–487.

STEJNEGER, LEONHARD, and THOMAS BARBOUR
1933 Check list of North American amphibians and reptiles. Harvard University Press: XIV+185 pp.

WOODBURY, ANGUS M.
1931 A descriptive catalogue of the reptiles of Utah. *Bull. Univ. Utah*, Bio. Ser. VI (4): 1–129.

DEPARTMENT OF ZOOLOGY, UNIVERSITY OF CALIFORNIA AT LOS ANGELES, CALIFORNIA.

The Survival Value of Specific Characters[1]

By EMMETT REID DUNN

G. C. ROBSON, in "The Species Problem," and Arthur Paul Jacot, in "The Status of the Genus and the Species," have recently stated that it is often difficult or impossible to explain the structural differences between the species of a genus in terms of selective or survival value. Robson's "suspicion that many interspecific and intervarietal differences are devoid of survival value," and Jacot's statement "to my knowledge, no one has yet pointed out how . . . the specific differences between the four species of non-sylvan frogs [in New England] give the one an advantage over another," are, I think, fairly indicative of their perplexity when confronted with a situation which is, and has always been, a great stumbling-block to the Darwinian theory.

Jacot, indeed, suggests that the species of a genus have "the same combination of structural characters which are usually so poorly developed as

[1] Contribution from the Department of Biology, Haverford College, No. 18.

to be of no immediate adaptive or selective value in the process of evolution," and that it is "only when structural differences are of generic, more especially of family rank that they are positive enough to be of *selective* value." However, if one rewords the latter statement to read . . . only when structural differences are positive enough to be of *obvious selective* value are they usually considered to be of generic, more especially of family rank . . . it assumes its proper relationship to the actual process of classification and simultaneously loses its significance.

A genus reduced to its lowest limit would consist of a single *formenkreis*; a set of vicarious forms, races, or species, each occupying the same ecologic niche in its own area. It would be distinguished from other genera by obvious structural characters (which usually have obvious relationships to life in that niche, i.e., obvious selective value), with the corollary that each other genus would occupy some other niche and have its own structural characters. That the genus in practice is, in the best known groups of animals (birds and mammals), rapidly approaching as a limit this theoretical genus, may be seen by a glance at any recent check list. To all intents and purposes genera are becoming monotypic; or, rather, are being restricted to contain only a single *formenkreis,* although there may be a large number of distinct forms (species) or intergrading geographical races (subspecies). That the species of a genus do not differ from each other by characters of such obvious selective value as do genera of a family is not surprising, since this is, and has always been, implicit in the concept of genera and species, and is, indeed, the basis for that concept. The question of the selective value, if any, to be found in the structural differences between species and races is therefore, by definition, always one of great difficulty, since if these differences and their selective value were really obvious the species would be placed in different genera.

We must disregard differences which are not hereditary, as Darwin repeatedly stated, although numerous critics, who appear not to have read the "Origin," have even more repeatedly stated that his theory of Natural Selection was based on some form of non-heritable variation. Although without experiment it is impossible to decide whether any individual difference is hereditary or not, those experiments which have been made show clearly that most of the characters the systematist uses for discrimination are hereditary.

R. A. Fisher, in "The Genetical Theory of Natural Selection," has subjected the various theories of descent with hereditary modification to penetrating mathematical analysis, and has brought to light some extremely significant relationships.

He has pointed out an astounding contrast between the status of Selection as a force in directing evolution, and the status of all other forces which have been suggested, as Use and Disuse, Environmental Causation, Orthogenesis, etc. These latter forces have suffered increasingly from lack of evidence, from lack of any known or imagined mechanism, and from the fact that actual, observed, hereditary modifications cannot be so interpreted. Fisher has shown that an hereditary change which occurs once in every hun-

dred thousand individuals can never spread through a species beyond the point where it occurs in one in every thousand if it entails a selective disadvantage of only 1%. A mutation rate of one in one hundred thousand is vastly higher than any yet observed. This proves that no species was ever driven to extinction by acquiring adverse hereditary modification.

Should such an hereditary change, occurring once in every hundred thousand individuals, be indifferent as regards selective survival, "a lapse of time of the order of one hundred thousand generations would be required to produce an important change with respect to the factor concerned, in the heritable nature of the species." If, then, it exists in a large number of individuals in each generation, i.e., if it is a "specific character," it must be supposed either that it has appeared *de novo* at a rate tremendously greater than ever observed, or that many millions of generations have elapsed since its original appearance (for a single appearance, its presence in a thousand million individuals would indicate that it originally appeared at least 280 million generations ago). It may be noted that the number of generations from *Dryopithecus* to the two thousand million individuals of *Homo* is of the order of 800,000.

Charles Elton, in "Animal Ecology," offers the suggestion that indifferent hereditary characters may spread into a species when the population is reduced to a low ebb after one of the violent and often periodic fluctuations which are known to occur in many species. He suggests that the few survivors may carry indifferent genes, which then become the common property of the increasing population.

Robson selects two species of British hares to show that specific characters have no survival value. Since hares and rabbits afford the stock examples of periodic fluctuation in numbers, this case seems to support Elton's view.

I am not yet convinced that fluctuations of the sort described by Elton are so usual as to affect a general consideration of the occurrence of indifferent characters. In any case, since the propagation and spread of indifferent characters is entirely subject to the laws of chance, a mathematical investigation should show whether such propagation and spread is more favored by a violently fluctuating population than by a stationary one. I fear that such an investigation would inquire into the chances of such carriers being among the survivors; that such chances would be found to be slim; that periodic, regular, fluctuations in numbers would not alter the general conclusions drawn by Fisher for a stationary population; and that it would leave the presence of widespread and indifferent hereditary characters (if such exist) as unexplained as before.

Fisher has not considered this particular possibility, although he has shown that in a diminishing population the chances of success of any new hereditary trait are much lessened, whereas in an increasing population the chances of such a trait, good, bad, or indifferent, are much increased.

Fisher, naturally, is chiefly concerned with *Evolution* in the larger sense of the word, with large populations and their gradual change as new hereditary characters are added and older ones eliminated.

There is a phase of evolution known as *Speciation,* whereby a single species is split into two. This also takes place by the addition of new traits and by the elimination of older ones, but the addition and elimination are not the same for two groups of the population, so that these two groups eventually become dissimilar. Fisher deals with this process, but not at any length, and he does not suggest that in many cases of speciation the process may be initiated by the isolation from the general population of an extremely small group. This might be especially true for insular forms. It seems to me that the isolation of small populations (even of single individuals) might serve to account in some measure for the presence of indifferent characters in their descendants.

Vertebrate taxonomists have long been aware that many of the hereditary differentiating characters of various forms on a continental area can be correlated with the features of the vicarious environments, and one set of such facts has been put into a generalization known as Allen's "Law." This correlation is by no means so clear on the islands of an archipelago, and such cases have often been adduced as examples of "evolution without natural selection." Natural selection, like the second law of Thermodynamics, or any other generalization which purports to account for the behavior of large populations, cannot be expected to describe that of very small populations with anything like the same accuracy. Darwin himself said that Natural Selection would work more effectively on a continental area with large numbers. Fisher's mathematical treatment deals with large numbers. *Evolution,* in the sense of *adaptation,* has obviously gone further in the larger continental populations than in the smaller insular populations. *Speciation* is in inverse ratio to the size of the areas (and the populations), and in direct ratio to the number of small, isolated populations, as set forth in Jordan's "Law."

Should an hereditary change confer a selective advantage of 1%, the situation is completely altered. Such a change, occurring once, has a chance of 1 in 50 of sweeping over the entire species. Should it occur 250 times the odds are 100 to 1 that it succeeds. If the population is the thousand million mentioned obove, a rate of one such change in a thousand million (not one per 100,000) will produce one a generation, and hence establish the new type in from ten to 250 generations (not 280 million generations). This rate of hereditary change is much lower than that actually observed. At a rate of one such change in a million there would be 1000 of the new type in each generation, and even at the low selective value of 1% it would be established almost immediately.

The efficacy of a selective value of 1% may be regarded as established by Fisher's analysis. The difficulty of detecting such a value in the field is obvious, and for most cases may be said to be impossible. But that such a value may exist cannot be denied. Should differences of this low selective value exist, no theory of descent with modification save Natural Selection need be considered as of any significance, even though proven possible, since Selection is so much more potent. The existence of adverse selective values amounting to 100% has frequently been shown, and I shall later describe a

case where nearly 100% favorable selective value exists as concerns a particular species and a particular predator.

That differences of approximately 4% in weight are individually inappreciable, but that in tests amounting to 300 they are on the whole correctly gauged, has been brought out in Urban's experiments, quoted by Fisher, who comments: "selective advantage will increase or decrease continuously, even for changes much smaller than those appreciable to our own senses, or to those of the predator or other animal, which may enter into the biological situation concerned." That such small and unappreciable differences, when taken in large numbers, are regularly efficacious, the whole experience of the race attests. Natural Selection and the Second Law of Thermodynamics, whose similarity Fisher points out, both rest on the mathematics of chance. The psychological opposition to Natural Selection is the mental trait on which professional gambling houses rely. As Fisher says "The income derived from a Casino by its operator may, in one sense, be said to depend upon a succession of favorable chances, although the phrase contains a suggestion of improbability more appropriate to the hopes of the patrons of his establishment."

McAtee, in "Effectiveness in Nature of the So-called Protective Adaptations in the Animal Kingdom, Chiefly as Illustrated by the Food Habits of Nearctic Birds," and in "Warning Colors and Mimicry" (the latter a review of a paper by Cott entitled "On the Ecology of Tree-frogs in the Lower Zambezi Valley, with special reference to Predatory Habits considered in relation to the Theory of Warning Colours and Mimicry"), attacks the notion that specific characters have survival value. Jacot, Robson, and Elton have, at most, questioned the survival value of certain specific characters, and, together with Fisher, urged the necessity of more ecological work. McAtee does not question. He states, quite vigorously, his disbelief in survival value, and supports it with masses of data which are, at first sight, extremely impressive.

Organic Evolution, or Descent with Modification, is a generalization which coordinates such a vast number of facts that scarcely any biologists oppose it. Five methods of Evolution have been proposed: inheritable novelties produced and directed by the desires of the organisms; inheritable novelties produced and directed by the activities of the organisms; inheritable novelties produced and directed by the environment of the organisms; inheritable novelties produced and directed by the nature of the organisms; and inheritable novelties produced by no known cause and quite undirected but surviving or perishing in so far as they confer positive or negative survival value upon their possessors. Only the last, Natural Selection, is based upon any ascertained facts, and only the last is, as yet, unopposed by anything known concerning the origin, inheritance, and fate of new traits. The first four are unsupported by any known facts, and are opposed by many.

McAtee's attacks upon this method of modification by descent therefore demand investigation. His data, "an imperishable record," are the stomach contents of 80,000 birds, and the identification of 237,399 animals upon which they fed.

I am willing to accept McAtee's data, but I cannot accept his interpretation.

His title would indicate some consideration of "the effectiveness in nature of the so-called protective adaptations." To my mind, this can be done properly only by intensive study of specific cases, including habits, characteristics, habitats, and predators, together with statistics on the population, death rate, etc., carried on over a number of years. For such work the unpublished data in the files of the Biological Survey, which McAtee has summarized, may be extremely useful. Meanwhile the best known species is *Homo sapiens,* and the data in this case are admittedly insufficient. A little is known about a few other species. For the majority our information is extremely slight.

McAtee manipulates his enormous body of data in such a way that it apparently indicates:

1. Birds have indiscriminate feeding habits.
2. Organisms are preyed upon by birds in proportion to their relative abundance as individuals in nature.
3. So-called protective adaptations do not exist.

The first proposition is evoked by the simple process of lumping the stomach contents of all the individuals and species of birds examined, so that the large and varied bird fauna of over 500 species appears in the statistics as a single predator, with, of course, quite indiscriminate feeding habits.

The actual data, sometimes given, tell a different story. A single bird species, the pigeon hawk, accounted for over 79% of the butterflies eaten, and 15 species of birds, or less than 3% of the number of bird species in the area considered, accounted for 100%. The data in this case do not indicate particularly indiscriminate feeding.

That *Rana* is more largely found in the stomachs of birds than are other amphibians is attributed by McAtee to its relatively greater abundance. But when he says "greater numbers proportionally of the stomachs of aquatic birds have been examined than of any other group" he opens the way for a different interpretation.

The second proposition is evoked by a process entirely independent of McAtee's data. This consists of the asumption that the relative number of species in a group is a fair guide to the relative number of individuals. This assumption is probably correct provided it is *never* applied to single cases. The correlation suggested undoubtedly exists in the case of the class Insecta, but is not necessarily true for any single taxonomic group, and is manifestly untrue for many. It is entirely irrelevant in reference to protective adaptations, which are, by definition, possessions of individuals and species, as against other individuals and species.

As an example of McAtee's use of this assumption, he asserts that Ranidae are more numerous in nature than Bufonidae or Hylidae. In the absence of actual population counts (of which there are none) one must fall back on general impression. My own opinion, drawn from some eighteen years of observation in the northeastern United States, is that the individual number

of bufos equals if it does not exceed the individual number of ranas, despite the fact that some five species of *Rana* can be found there, and only two of *Bufo*. Away from the northeast, in more arid country, the specific superiority of *Rana* disappears, and the indications are that bufos are even more relatively abundant as individuals.

McAtee takes the "Check List" of Stejneger and Barbour (1917) and counts the total number of amphibian species. Then, counting the number of species in each family, he works out the ratio to the total number to four places of decimals. He uses the same procedure in all animal groups. This ratio, he asserts, is a reliable guide to the relative number of individuals in each family in the United States. The number of fallacies involved in this procedure is remarkable. Firstly, the relative number of species in any of the families concerned is not the same in the 1917 check list as in that of 1923, and is again changed in that of 1933. Secondly, any such list is a matter of judgment, and not, as appears from the differences between editions, infallible. Thirdly, to work out such personal judgments to four places of decimals is either folly, or an attempt to produce a false impression of accuracy. Fourthly, and most important, it is highly dubious that a statistical proposition true in the large will hold when two individual situations are contrasted. To assert that it holds in such instances is either naive or disingenuous, and in either case is a flagrant misuse of the statistical method.

The North American species of *Rana* amount to 12.0564% of the total number of North American amphibian species, according to McAtee's computation. Species of *Bufo* amount to 9.9288%, i.e., a ratio of 6 to 5. In nature birds ate, of amphibians, *Rana* 53%, *Bufo* 6%, or, roughly, about nine times as many ranas as bufos. The correlation between bird predation and specific abundance is not too complete.

In Pennsylvania the species of *Bufo* and *Rana* are in a ratio of 2 to 5 respectively, as contrasted with McAtee's ratios of 5 to 6 respectively for the whole country. We have for that state Surface's "imperishable record" of stomach contents of snakes in his "The Serpents of Pennsylvania." Those snakes should have eaten even more frogs in proportion to toads than McAtee's birds did in the entire country (9 frogs to 1 toad). Actually they ate 1 frog to 3 toads. A more glaring discrepancy is scarcely conceivable. It would seem that it is highly unsafe to argue numerical superiority of individuals from numerical superiority of species or from their prevalence in stomach contents. Stomach contents *may* be based on something else, namely, adaptation of predator to prey, cr protection of prey from predator. The argument is a circular one, with only one outside check, and that an assumption. Stomachs are filled with the most abundant prey; the prey is most abundant because it fills the most stomachs. The outside check is that the number of species is a guide to the number of individuals, which is not necessarily true. At any rate frogs cannot (in Pennsylvania) be more numerous than toads in a ratio of five to two, and simultaneously less abundant in a ratio of one to three. McAtee's theory is completely incompetent to account for these facts. Another theory is better able to explain them. "Greater numbers . . . of *aquatic* [italics mine] birds" is the preferred ex-

planation of McAtee's data—not greater numbers of *Rana*. This explanation is "Darwinian" rather than "McAteeian."

McAtee himself states on page 121 that the over-representation of Ranidae "is explained in part by the fact that greater numbers proportionally of the stomachs of aquatic birds have been examined." On page 123 he says "with no doubt whatever the difference in amount of predation on these two groups [frogs and toads] is a direct reflection of their relative abundance." Comment on these two statements is unnecessary.

The third proposition is evoked by a combination of the errors and omissions which produced the first two, and by continued lack of attention to individuals and species. The prey are considered by families, a method which may well obscure "the effectiveness in nature of so-called protective adaptations" unless they are shared by the entire family as against the entire class Aves. I regret, in view of the vast labor of gathering the data, that the method of using it appears to me completely fallacious and misleading. One might as well argue that, since death comes to all men, there is no such thing as relative immunity to a disease. Birds are a numerous and a well differentiated group. That scarcely a family of animals is immune from their attacks has been brought out by McAtee, but it is hardly news. McAtee gives no analysis of *specific* feeding habits on the part of the predators, and gives the data concerning the prey in such a way that no one could tell whether any *species* was better off than any other. This method of setting a *class* of predators against *families* of prey would, I believe, always and infallibly show indiscriminate feeding habits by the predator, predation in relation to abundance of prey, and absence of selective adaptation on the part of the prey. Once the data were gathered anyone could manipulate them in McAtee's way and reach McAtee's conclusions. Unfortunately, it does not mean anything, save adaptive radiation by the class Aves.

The stomach contents recorded by Surface and by Cott, while not so numerous as McAtee's original data, are not manipulated; show the natural feeding habits of species, not classes; and, as far as possible, the prey are identified as species, not families. These data indicate conclusions extremely remote from those of McAtee, who does not present the specific data. It is possible, and, wherever we are allowed to see it, appears probable, that McAtee's data would not confirm his conclusions.

McAtee generalizes his data into a theory of the feeding habits of birds. This theory may be set down in his own words: "we cannot admit . . that the analyses of the stomach contents of birds fail to reveal the approximate numbers present of certain insects" (1932: 4). "Availability is a mighty factor in the choice of food by birds. Within the limits imposed by special habitats, bodily modifications, and the relative size of predator and prey, birds are prone to feed upon what is abundant and easily obtained" (1932: 135). This is modified by "greater or lesser restriction of predators to specific habitats in each of which the range of food items is different, and because of the specialization of various predators in methods of seeking food" (1932: 136). "This principle, predation in proportion to population, stands out clearly . . . the ruling criterion in choice of food is availability" (1932: 136). "Animals take what is most available at the particular time and place.

Availability of course is qualified by the size of the animal in relation to possible prey, specializations as to food, etc., but in general availability means *abundance*" (1932: 212).

Mr. Arthur Loveridge, who compared Cott's paper with McAtee's criticism of it, made some notes which he kindly allows me to quote. His note on the last sentence quoted from McAtee is "Nonsense, save for qualification which nullifies."

"In general, availability means *abundance*." If the so-called adaptations do not exist, then predators should be found subsisting on the most abundant material present in any vicinity, i.e., the material present in greatest gross mass. But this most "available" material is, on the land masses, various inorganic compounds of silicon, and I am unaware of any predator which chooses its food on this basis. Next most abundant, and hence "available" material is cellulose, and a vast number of predators are quite incapable of utilizing it. If availability means abundance, and if said availability is the ruling criterion in choice of food, the presence of carnivores in the world is an unsolved mystery. The gross mass of protein material present in the bodies of *Homo sapiens* and the larger domestic animals is enormous, but this abundance is not the "ruling criterion" in the choice of bird food as far as one can judge by McAtee's papers.

McAtee uses the word *availability* and says it means "abundance," but it has another and a quite different meaning. This meaning is more stressed by dictionaries than by McAtee; is quite a bit teleological, implying a capacity to use and to be used, and has not the remotest implication of abundance. Using the word in this sense, *Homo sapiens* (despite his abundance) is not available as food for birds. But this implies either lack of adaptation on the part of the predator, or presence of adaptation on the part of the immune species. The comparative immunity of man to predation by birds in North America may even be an example of the "effectiveness in nature of the so-called protective adaptations in the animal kingdom, chiefly as illustrated by the food habits of Nearctic birds." The word availability used in this (the dictionary) sense is simply another word for adaptation.

Cott points out quite clearly certain differences in the feeding habits of frogs on the lower Zambezi, in the same habitat. McAtee says "it is clear that we are reading a record of availability, and that the frogs were feeding more or less indiscriminately on what was available to them." Now if "availability means abundance" certain species of these frogs were habitually eating less "available" food material than others, since in the same ecologic niche ants cannot be more abundant than Hemiptera and Diptera in a ratio of 90–5, and simultaneously less abundant in a ratio of 11–72, which ratios appear in Cott. If "availability" may be qualified by McAtee's "specializations as to food," Cott's modest attempts to elucidate these specializations cannot be attacked with propriety by the author of the qualifying phrase.

McAtee devotes little space to attacking Cott's major findings and much to attacking minor details. For instance, Cott says of *Megalixalus fornasinii*, which, seated, has a most extraordinary coloration, "To human eyes, at any rate, the creature ceases to bear any marked resemblance to a frog." McAtee remarks "he publishes illustrations that show quite clearly it does look like a

frog," which statement is, at least, misinterpretation. Cott publishes five illustrations of this frog, of which three are drawings intended to translate its appearance into frog-like terms, one is a photograph of the underside of a dead and dissected specimen, and one is a photograph of a living individual in nature in a seated position. The first four, quite naturally, look like frogs. If McAtee considers that the last looks like a frog, he is free to do so, but Cott, Loveridge and myself consider that it does not "bear any marked resemblance to a frog." It may be invidious to remark that anyone of the three of us has had vastly more experience with tropical tree-frogs than has McAtee.

McAtee says on page 210 of his criticism that "acrid or poisonous skin secretions are of common, perhaps of universal, occurrence among frogs and toads." But when Cott says "poisonous skin secretions are of common occurrence among Anura. In many species they are known to furnish an effective means of defense," McAtee, on page 211, takes issue as follows: "If the word *many* is taken at its ordinary valuation this is a definitely untrue statement," "There is no evidence of any frog being dangerously poisonous either to snake or bird predators upon it, hence the alleged discrimination is a myth."

The criticism is, of course, qualified by a phrase which nullifies it. It is definitely true to state that many species are protected against some animals by their skin secretions, which in some forms are sufficiently powerful to kill dogs who even mouth them. That some predators may be immune to these poisons does not make Cott's statement untrue.

Terrapene eats *Amanita* with impunity, and *Agkistrodon* may bite *Lampropeltis* without seriously harming it. Certain predators are notoriously immune to the poison of their prey. That the prey is really poisonous, however, is not a matter for doubt or sarcasm. Few of us are, I fear, immune to the poison of *Amanita muscaria* or of *Agkistrodon mokasen.*

Jacot's previously quoted statement concerning New England ranas: "no one has . . . pointed out how . . . the specific differences . . . give the one an advantage over another" tempts me to set forth a few facts regarding *Rana palustris* and *Rana pipiens* in the eastern United States, which may point out a possible relationship between the specific characters and survival value, but which will also point out the need for enormously more detailed work in the field before the whole problem of the relationships between these two closely allied species is solved.

Boulenger, in "A Monograph of the American Frogs of the Genus Rana," gives the best analysis to date of the *anatomical* differences between adults of the two species. From this analysis the following facts may be abstracted:

1. *Rana pipiens* is more variable than *Rana palustris* in most characters. This variability is usually enough to spread over *palustris* in both directions. When it is not so sufficient most of the characters of *palustris* are included by the variability of *pipiens.*

2. There are a few characters which cannot be so stated. These are: (a) *pipiens* has the dorso-lateral folds narrow or moderately broad, usually with intermediate folds or elongate warts between them; *palustris* has the dorso-lateral folds very broad, with a pair of similar folds between them;

(b) *pipiens* has the lower parts white; *palustris* has the posterior part of belly and hind limbs yellow or orange; (c) *pipiens* has the diameter of the tympanum equal to ½ the diameter of the eye; *palustris* has it equal to ⅗ to ⅚ the diameter of the eye; (d) *pipiens* is brown, gray, olive, or bright green, with dark brown or black spots usually disposed with great symmetry, rarely without spots; *palustris* is brown, with rows of very large, often squarish, dark brown or black spots along the back.

These are *all* the specific differences that Boulenger was able to find. He admits the distinctness of the two species, but emphasizes their close similarity. Wright, in "North American Anura," points out various differences in their behavior, breeding habits, eggs and tadpoles which need not be brought into the discussion. The differences in the dorso-lateral folds and the color of the posterior ventrum serve not only to differentiate *palustris* from *pipiens*, but also to differentiate *palustris* from all other ranas in the area concerned, i.e., *palustris* is, in these respects, a specialized derivative of *pipiens*. The greater development of the dorsal folds of *palustris* is, since these folds in frogs are glandular, equivalent to a greater development of the integumental glands. That such greater development of the glands may have a selectional value in favor of *palustris*, the following facts would seem to support.

1. Wright suggests that the skin secretions of *palustris* are poisonous. He says "the rear ventral parts are a bright orange, the color so frequently associated with poisonous properties in Anura. A dog or any other animal which has had experiences with the secretions of the pickerel frog would no sooner try to eat one than it would a toad. Frequently we have made the mistake of putting live pickerel-frogs in jars with other forms, and have found the jar extremely frothy by the time the laboratory was reached, and not infrequently some of the other species were dead, apparently as a result."

2. Surface, in "First Report on the Economic Features of the Amphibians of Pennsylvania," gives as local Pennsylvania names for *palustris*, "poison frog," and "poison bully."

3. I have often tried the experiment of offering *Rana palustris* as food to captive garter snakes (*Thamnophis sirtalis*). I am fully aware of McAtee's strictures on the experimental method in such cases as reported in "The Experimental Method of Testing the Efficiency of Warning and Cryptic Coloration in Protecting Animals from their Enemies." I cannot regard all his criticisms with the proper awe. In some cases he meets the facts reported by the experimental observers with other facts which contradict them, and in these instances I am willing enough to give McAtee's facts their due weight; but in other cases he counters the observed experimental facts with nothing more weighty than his own opinions, and in these instances I am afraid that I am more impressed by the experimental facts. There are many such examples in McAtee's article.

In the situation reported the garter snakes were sufficiently at ease to be almost continuously about the business of sex. They were sufficiently hungry to seize immediately any frog offered. These two facts, to any unprejudiced mind, mean that conditions of captivity scarcely vitiate the fol-

lowing observations. In endeavoring to provide these unabashed and voracious snakes with food, I naturally offered them the most easily obtainable Salientia. These were (in the vicinity of Haverford, Pennsylvania) *Bufo americanus, Rana clamitans,* and *Rana palustris.* The first two species were taken and eaten with avidity. *Rana palustris* was always seized with the same eagerness, but the results were very different. The attacking snake *always* released the frog, uninjured and in short order. The snake then proceeded to gape and yawn, and go through the motions of ejecting a mouthful (although nothing was actually in the mouth), then to move about and continually wipe or rub the side of the mouth against the floor or walls of the cage. McAtee rather caustically rejects the reports of similar behavior of birds in captivity, when confronted with what appeared to the observers as distasteful food, with the comment that such actions are *normal* to birds in nature even when they have not tasted anything. I consider my own experience with snakes sufficiently extensive to state, without fear of contradiction, that such behavior is extremely *abnormal* in or out of captivity.

4. Surface, in his counts of snake stomach contents in Pennsylvania, gives *no* instance of pickerel frogs being eaten by *any* snake, whereas the other common Pennsylvania frogs are all listed as snake food.

These observations indicate that one of the specific characters of *Rana palustris* (namely, the development of integumental glands) gives it a high survival value against one predator (*Thamnophis sirtalis*).

In my opinion, should one desire to give a frog an advantage in life over another, he would not be better advised than to confer on it immunity to the garter snake, which is, in upland regions of the eastern United States, the most common and ubiquitous snake which preys on frogs. This advantage, I consider, is possessed by the pickerel frog, and that at a rate of close to 100%. Considering Fisher's mathematical demonstration of the advantages of a 1% selection value, the selective value of the glandular ridge equipment of the pickerel frog is sufficiently demonstrated.

The significance, if any, in terms of selective value, of the other characters which differentiate *palustris* from *pipiens* cannot be pointed out at present. It must not be forgotten that most hereditary changes have more than one effect (since the determiners go into every cell of the body) and that if some of these effects are of positive selective value they may well carry with them other effects which are quite indifferent. Therefore, many *visible characters* may have no selective value but may be incidental by-products of genes which may have, physiologically, very positive selective value. This conclusion was pointed out by Darwin many years ago. Should some of the effects of an hereditary change be of adverse selective value, the other effects would have to be of proportionally greater positive selective value, otherwise the former could not exist at all as specific characters.

There is no occasion here to go into the physiological, hereditary differences between *Rana palustris* and *Rana pipiens,* which are very real, and which express themselves in many ways such as: reaction to temperature, choice of habitat, behavior, call, etc.; or into the morphological, hereditary differences between the two which express themselves in the character of the

eggs and the tadpoles. There are *many* more such differences between the two than can be noted in anatomical comparison of the adults. *All* such differences must be considered before any sound analysis of the evolutionary relationships of the two is reached. I have simply wished to point out a possible value of *one* adult specific character.

I must, however, make a few comments on the ranges of *palustris* and *pipiens,* which are seldom correctly cited.

I write from Haverford, Delaware Co., Pennsylvania, a locality where *pipiens,* "the most common frog in North America," has never been taken. In this locality *palustris* is extremely common. In this county, where records of *palustris* practically cover the map, *pipiens* has been taken only in the swamps along the Delaware. Not many miles away are the pine barrens of New Jersey, and *pipiens* is everywhere in this area. Not a single *palustris* is known from the pine barrens. For eastern Pennsylvania the records put *pipiens* as occurring along the Delaware and the Susquehanna, and not elsewhere, while *palustris* is generally widespread. Around Northampton, Massachusetts, a careful survey of the region showed that, in going up from the Connecticut River, *Rana pipiens* was limited to below the 250 foot level in the valleys, while *palustris* showed no such limitation. *R. pipiens* is unknown in Piedmont, Virginia, while *palustris* is common. Much more work along these lines needs doing, but it is quite apparent that large areas in the eastern highlands are held by *palustris* to the exclusion of *pipiens.* That altitude is not the determining factor is indicated by plenty of high altitude records for *pipiens* in the west. I have caught *pipiens* at El Copey, Costa Rica, at about 6,000 feet above sea level.

The ranges, as well as the anatomy, of the two would suggest that *palustris* is a derivative of *pipiens.* It is surrounded by its parent species, and neither exists in the territory preëmpted by the other, despite much overlapping along the boundaries. Jacot's suggestion that *palustris* may be "relegated to cooler waters by *R. pipiens*" does not seem to fit the facts. The derivative species seems rather to have ousted its progenitor.

This case of *Rana palustris* is an example of the survival value of a specific character, or rather of the practical utility of the character in which it differs most notably from its closest relative. Increase of knowledge should multiply such examples rather than diminish them.

Further study should be directed, as Jacot suggests, *not* to the utility of a character as such, but to the values of characters which differentiate individuals and varieties of the same species, or of two very closely allied species. Our actual knowledge of the process and methods of evolution will come, as it has come in the past, from contrasts between individuals, varieties, races, and species, rather than from attention to genera, families, orders, or classes.

References

Boulenger, G. A.

1920 A monograph of the American frogs of the genus Rana. *Proc. Amer. Acad. Arts and Sci.,* 55 (9): 413–480.

COTT, H. B.
1932 The Zoological Society's expedition to the Zambezi, 1927; No. 4. On the ecology of tree-frogs in the lower Zambezi Valley, with special reference to predatory habits considered in relation to the theory of warning colours and mimicry. *Proc. Zool. Soc. Lond.*: 471–541, pl. 1–2.

ELTON, C.
1927 Animal ecology. Macmillan.

FISHER, R. A.
1930 The genetical theory of natural selection. Oxford.

JACOT, A. P.
1932 The status of the genus and the species. *Amer. Nat.*, 66: 346–364.

MCATEE, W. L.
1912 The experimental method of testing the efficiency of warning and cryptic coloration in protecting animals from their enemies. *Proc. Acad. Nat. Sci. Philad.*: 281–364.
1932 Effectiveness in nature of the so-called protective adaptations in the animal kingdom, chiefly as illustrated by the food habits of Nearctic birds. *Smithsonian Misc. Coll.*, 85: 7.
1933 Warning colors and mimicry. *Quart. Rev. Biol.*, 8 (2): 209–213 (review of Cott).

ROBSON, G. C.
1928 The species problem. Edinburgh: Oliver and Boyd.

STEJNEGER, LEONHARD, and THOMAS BARBOUR
1917 A check list of North American amphibians and reptiles. Harvard.
1923 *Ibid.*, Ed. 2.
1933 *Ibid.*, Ed. 3.

SURFACE, H. A.
1906 The serpents of Pennsylvania. *Monthly Bull. Div. Zool., Penn. Dept. Agric.*, 4 (4–5): 115–202.
1913 First report on the economic features of the amphibians of Pennsylvania. *Ibid.*, 3 (3–4): 67–152.

WRIGHT, A. H.
1914 North American Anura. *Carnegie Inst. Wash.*, Publ. 197.

DEPARTMENT OF BIOLOGY, HAVERFORD COLLEGE, HAVERFORD, PENNSYLVANIA.

Herpetological Notes

HIBERNATION OF *FARANCIA ABACURA* IN CAPTIVITY.—The feeding habits of the mud snake, *Farancia abacura,* in captivity have been described in a previous article (COPEIA, July, 1934). Four specimens fed freely throughout the spring and summer on *Amphiuma tridactylum,* the so-called "conger eel," the largest of the snakes consuming seventeen of the amphibians during the five months from May to September. With the approach of cold weather it was decided to experiment with hibernation in captivity with this large specimen.

The snake ate the last "eel" on October 4 and from then on, in spite of several weeks of continued warm weather, it persistently refused to feed. On October 24 it was measured and weighed, showing a length of 65 inches (8 inches gain since May 1) and a weight of 3 lbs. 11 oz. By this time the snake showed an evident desire to dig into the ground whenever opportunity offered. The plan devised for the winter home was as follows:

Close to a small pond a hole was dug large enough to accommodate an ordinary wooden packing case thirty-six inches long by thirty inches wide and thirty inches deep. The bottom of the hole was just about at the water level at the time of digging but after heavy rains this was frequently a foot or so higher. Small holes were bored in the side and bottom of the packing case to permit free access of water. A layer of about four inches of mud was put into the bottom, then some excelsior and the snake placed in the box as an experiment for one night. When the excelsior was removed the next day the snake had disappeared into the mud, so the excelsior was removed, a layer of dead leaves was put on the mud and then the box was filled with alternate layers of mud and leaves except at one end where leaves only were used to permit easy passage from the bottom to the top. The box was covered with a heavy wire screen and then with sheet iron to keep out beating rain. This was on November 4. A dish of fresh water was kept on top of the mud inside the box throughout the hibernating period.

There were several periods of freezing weather during the winter, the lowest temperature being 20° F. on January 21. On all warm days the hibernating box was examined but there was no sign of the reptile until February 14 when it was found lying on top of the mud near the water pan. There was a hole down through the leaves in one corner of the box. The snake was not disturbed and the next morning it had disappeared, not to be seen again until twenty days later, during which interval there were several successive nights when the temperature was below freezing. March 6 when the snake was again above ground it was taken up and found to weigh 3 lbs. 10 oz., only one ounce less than the weight four months and ten days before. This very small loss in weight was surprising but the weights both before and after the hibernation were carefully checked and the same scale was used in both cases.

The snake appeared to be in good condition at this time. There was no sign of moulting nor was there any evident emaciation. Tongue action was frequent and the body motions were no more sluggish than usual. When replaced in the box the snake again disappeared for two weeks, finally reappearing on March 18. It was then allowed to crawl about on the grass and was sprayed with water after which a medium sized *Amphiuma* was placed in a dish of water with the reptile as described in the previous article. The snake appeared interested but refused to feed and did not attack the amphibian even when the latter bit viciously into the snake's hide on one occasion.

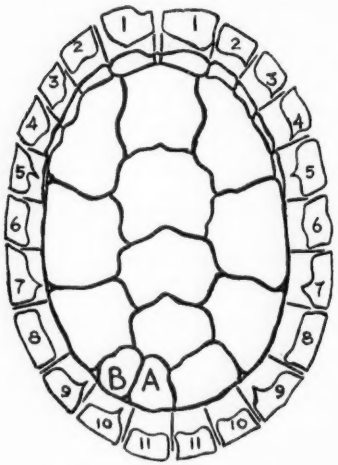
During the following week the specimen was not seen above ground even though the weather was quite warm, so on March 26 it was decided to dig down to see what kind of a "nest," if any, had been formed. Several tunnels were uncovered and the snake finally found at the bottom of the box loosely coiled in a pocket of wet leaves. It seemed probable that this spot had been the winter resting place. There was no evidence of any shed skin nor of excreta, and the only odor was that of rotting leaves.

The snake was taken up and sprayed with water after which it attacked and ate a 14 inch *Amphiuma,* the amphibian biting the reptile several times during the struggle. This was the first meal in five months and twenty-two days. Two days later another *Amphiuma,* considerably larger than the first one, was eaten.—GEORGE P. MEADE, *Gramercy, Louisiana.*

SHIELD VARIATION, REDUCTION, AND AGE IN A BOX TERRAPIN, *TERRAPENE CAROLINA*.—While collecting during the summer of 1932, a specimen of *Terrapene carolina* was found that exhibited a variation of the posterior vertebral and costal shields, and a reduction of the number of marginals; the latter condition being so unusual as to warrant attention.

The specimen, a male, was taken August 23, 1932, in a small wood near Vineland, Cumberland Co., New Jersey, the center of the South Jersey pine barrens. It was noisily rummaging about in the dry sticks and leaves which mat the sandy floor of the wood. Some eight feet away a female box terrapin was feeding on the stem of a mushroom.

Upon examination the male proved to possess a rather unusual arrangement of the costal and vertebral shields. Such a variation is, of course, not an unusual occurrence in this species, which presents this condition quite often—caused primarily by the uneven healing of shields scarred in brush fires. But the condition present in this case does not seem to be the aftermath of any uneven healing. The accompanying figure shows how the fifth vertebral (A) has been reduced in size and has grown entirely upon the left side of the carapace, thereby compressing the left fourth costal (B). These are the only variations, the other shields being of normal size and appearance.



Upon closer scrutiny the specimen was found to have but twenty-two marginals instead of the usual twenty-four. Such a reduction is, as before mentioned, a condition so rare that, so far as ascertainable, it has never been recorded. The exact cause of such reduction is a problem which offers numerous theories, and possibly the theory in this case—barring the effect of brush fires which could not cause a reduction—is that the condition is entirely due to the variations described above; the shields being reduced to such a degree as to leave out two of the marginals that would normally lie beside them. It becomes obvious that the terrapin would have been of larger dimensions had the two shields (A and B) been of normal size.

The specimen has the letters *IE 1910* inscribed upon the plastron. The letters are very little distorted, therefore having been placed there about the time the terrapin was full-grown, about fifteen years of age. Were the inscription placed there on the date given, the creature would be about thirty-five years old. By careful count of the concentric rings of each carapacal shield an average of twenty-five years was obtained. Allowing for the wearing away of some of the rings by the weathering of many years, it is quite possible that the terrapin is thirty-five years old; not an unusual age for the species but interesting in the light of the marking experiments conducted on Long Island specimens of this species by Mr. J. T. Nichols.

In ending I would like to acknowledge the kind and helpful advice tendered by Dr. Raymond L. Ditmars and Mr. C. Ralph De Sola. The receipt of records on shield variation and age would be greatly appreciated.—C. M. KNOLL, *415 Washington Avenue, Grantwood, New Jersey.*

ENCOUNTERS WITH THE WESTERN SPADEFOOT, *SCAPHIOPUS HAMMONDII*, WITH A NOTE ON A FEW ALBINO LARVAE.—In view of the apparent wide interest of herpetologists in the genus *Scaphiopus* it may be well to record the following observations and encounters with the western spadefoot, *Scaphiopus hammondii*.

About 9:00 A.M., May 16, 1932, a small spadefoot, heavily spotted with red, was found hopping about in the warm sun on dry baked ground in the vicinity of Ensenada, Lower California. The finding of this individual under such circumstances seemed rather unusual in face of the nocturnal and secretive habits of the species.

Scaphiopus hammondii had been associated in my mind to such an extent with desert or semiarid regions that I was surprised to find it in the moist, well timbered Kaibab Plateau of Coconino Co., Arizona. Here larvae and newly transformed young were discovered July 1, 1932, in enormous numbers in Greenland Lake, a small pond situated in the Grand Canyon National Park at an elevation of about 8,000 ft. Many of the newly emerged "toads," still bearing a small tail and reminding one somewhat of *Ascaphus,* were found at a considerable distance from the pond, and many more were all ready burrowing into the soft mud in typical spadefoot fashion. Park Naturalist McKee has since written me that this is the first recorded occurrence of the spadefoot in the Grand Canyon National Park.

While collecting in Uintah Co., Utah, during the summer of 1933, I had a good opportunity of observing *Scaphiopus hammondii,* which is, with the possible exception of *Rana pipiens,* the most abundant amphibian in the Uinta Basin, occurring in the vicinity of occasional ponds and seepages in the desert and more plentifully in the irrigated sections. It appears not to enter the mountains in this region. The ponds formed by the overflow of irrigation water make admirable breeding places, where larvae and young toads may be found by thousands during the latter part of May and June.

At a place locally known as Desert Springs, southwest of Ouray, Uintah Co., large spadefoot larvae with hind limbs just developed were found to be abundant in a small pond used for watering cattle. On hot days the cattle spent considerable time trampling in the pond, stirring up the water till it seemed difficult for any tadpoles to survive. These larvae seemed to be feeding upon vegetable matter either contained in the cattle dung or growing upon it. The night of June 8, spent at this spot, I heard spadefoots calling. I would describe the call as a soft, though very penetrating *kwak,* low-pitched with something of the quality of the vibrating of a heavy rubber band. In a small trickle of water, running down a wash to the pond, I located, with the aid of a flashlight, several individuals—including one amplected pair, which was placed in a tin can. The female deposited her eggs before morning. Two weeks later I revisited the spot to find the pond drying, and newly transformed spadefoots emerging.

In the cottonwood belt along the Green River, about 15 miles southwest of Ouray, Uintah Co., adult individuals of *Scaphiopus hammondii* were relatively common after sundown. They were usually located by their rustling among the dried leaves, and then secured with the aid of a flashlight or lantern. Two individuals, collected May 26 and 29, contained eggs. Suitable breeding ponds were lacking in the vicinity; little more rain was to be expected, and it seemed unlikely that the river would overflow sufficiently at this point to form satisfactory pools.

A roadside pool, one of perhaps fifty similar pools within a three mile radius of Vernal, Utah, about 100 feet long and 10 feet wide, was visited June 18, when larvae in all stages of development were found. Seven days later, June 25, the pond was revisited, and was found almost dry due to a diversion of irrigation water. From a distance one could distinguish in the center of the mud expanse, that indicated the original area of the pond, a small oval patch that glistened brightly in the sun with a blue metallic sheen. On close examination, this patch, roughly 6 feet by 3 feet, proved to be a solid mass of stranded, writhing spadefoot larvae. Numerous small "toads" were hopping away to burrow immediately in the surrounding mud. With a large spade I collected six quarts of tadpoles and newly transformed "toads"; emptied about double that number into a nearby ditch, and left the rest to die in the sun. By counting the number of tadpoles to the quart I arrived at an approximation of about 30,000 for the little patch. Close to the pool three garter snakes, *Thamnophis ordinoides vagrans,* were captured. Two of these were found to contain spadefoot tadpoles.

In the initial visit to this last-mentioned pond, a number of peculiar, almost transparent, pigmentless tadpoles were seen. Only ten of these were collected as it was hoped to secure the transformed albino *Scaphiopus* at a later date. But a week later none of these albinos could be found among the stranded larvae remaining in the pond. Either they did not survive to complete their metamorphosis, or transformation had been accomplished. These larvae measure about 23 mm. total length, and are just beginning to develop the hind limbs. They are almost transparent, and the only noticeable color is contained in the vegetable matter in the intestines, and in the black mandibles and

teeth. Save in this lack of pigment they seem to differ in no respect from ordinary larvae. —WALLACE F. WOOD, *7130 Chabot Road, Oakland, California.*

FURTHER NOTES ON THE REPRODUCTION OF THE EASTERN BOX-TURTLE, *TERRAPENE CAROLINA* (LINNÉ).—Notes on the reproduction of the eastern box-turtle, *Terrapene carolina* (Linné), made during the summer of 1930 and 1931, have already been published.[1] The observations made during these two seasons indicated that some of the points in regard to the breeding habits of this turtle were not properly cleared up. For one thing the average number of eggs laid by a female at any one time, which was found to be 3, appeared too small. This the writer had come to attribute to the very dry weather prevailing for much of these two seasons. So he decided to repeat his observations during the seasons of 1933 and 1934.

Data on the number of eggs laid in a single nest and their respective dates of oviposition for 1933 follow,—2 eggs, May 28; 3, June 6; and 1, June 19. The same data for 1934 are,—2 eggs, June 1; 6, June 10; 4, June 12; 5, June 15; 4, June 20; 4, June 20; 6, June 27; 4, July 1, 7, July 2; 3, July 8 or 9; 3, before July 12; 3, July 13; 3, July 13; 1, much before July 15.

A very unusual thing was observed during these two seasons. A small female, Or. 30, which had a conspicuous scar on her carapace, laid twice during 1933 and twice during 1934. In 1933 she laid 2 eggs on May 28 and 1 egg on June 19. In 1934 she laid 2 eggs on June 1 and 3 eggs on July 13. Since this female was included in the observations made in 1930 and 1931, it is seen that here we have one particular reason for obtaining such a small average during these two seasons for the number of eggs laid in a single nest.

For the seasons of 1933 and 1934 the average number of eggs laid in a single nest was found to be 3.6 and the average number of eggs laid by a female for a single season was found to be 4.1.

By combining all the tabular data for the four seasons of 1930, 1931, 1933 and 1934 the following is obtained:

Largest number of eggs laid by one female in one nest — 7.
Largest number of eggs laid by one female in one season — 7.
Smallest number of eggs laid by one female in one nest — 1.
Earliest time of day for eggs to be laid in egg hole — 3:45 P.M.
Earliest time in day for completion of filling up of egg hole by female — 5:30 P.M.
Earliest date of egg laying — May 28.
Latest date of egg laying — July 14.

During the seasons of 1933 and 1934 mating or attempted mating frequently took place. It was observed that one male frequently would attempt to mate with another male, and not only would he mount but would insert his hind legs into the posterior leg pits of the other male. Following this the male underneath usually closed the posterior lobe of the plastron thus catching and pinching the posterior legs of the male that had mounted. This would cause the male on top repeatedly to snap at the head of the lower male. Males thus held together would retain such positions for many minutes before breaking apart. Impregnation of the female was never observed except when the male had assumed a vertical or backwardly inclined position. This position of the male indicates the final phase of the mating process. It may be held for many minutes or as much as an hour or more. Yet when a male and female in this position are disturbed they may quickly break apart.

Females separated from males during the season of 1934 reproduced as usual and gave a high percentage of fertile eggs. The duration of fertility in females thus separated from males is being made a special object of further study.—H. E. EWING, *U. S. National Museum, Washington, D. C.*

THE DESERT GRIDIRON-TAILED LIZARD.—On July 10, 1934, the writers collected 15 specimens of *Callisaurus ventralis ventralis* (Hallowell) in the vicinity to the south and west of St. George, Utah. The stomach contents of these lizards were examined microscopically in the laboratory. Only two of the stomachs contained plant fragments: one contained 6 blossoms, 1 arachnid, and 4 hymenoptera; the other con-

[1] COPEIA, 2, 1933: 95-96.

tained 1 plant leaf, fragments of 2 hymenoptera, and 1 leafhopper. One stomach was found to contain 23 termites and 2 lepidopterous caterpillars. Another held 1 grasshopper adult and 1 nymph, 1 buprestid, 1 false chinch bug adult, 1 hemipterous nymph, and 1 hymenopteran. A fifth stomach contained 6 ant lions, 2 hymenopterous adults, 5 pentatomids, 1 lepidopterous larva, 2 spiders, and numerous fragments. A sixth stomach held 3 bees, 2 chrysomelids, 1 *Agallia* and 1 other leafhopper, 1 pentatomid, and 1 ant lion larva. The total stomach contents of the fifteen lizards consisted of 1 nymph and 2 adult grasshoppers; 23 termites; 12 larval ant lions; 3 leafhoppers; 9 adults and 1 nymphal hemipteran, including 7 pentatomids, 1 big-eyed bug and 1 false chinch bug; 5 beetles including 1 buprestid and 2 chrysomelids; 5 lepidopterous caterpillars; 21 hymenopterous adults; 9 arachnids, 7 of which were spiders; 6 plant blossoms and one leaf, as well as numerous insect fragments. These lizards were collected among creosote brush, match brush, *Dondia*, and other brushy range plants. The species was moderately abundant from St. George (Utah) to Little Arizona (Arizona). Some of the females contained as many as 3 large eggs, which filled much of the abdominal cavity; some of these eggs measured 19 to 22 mm. in length, with maximum widths of 9 to 11 mm.—George F. Knowlton and Clyde F. Smith, *Utah Agricultural Experiment Station, Logan, Utah.*

THE SEX RATIO IN THE SALAMANDER *HEMIDACTYLIUM SCUTATUM* (SCHLEGEL).—To determine the relative numbers of the two sexes it is necessary to exclude the adults, for the differences in the habits of the sexes make it impossible to get fair samples of each at the same time. There appears, however, to be no sex difference in the habits of the juveniles.

The largest collection of sexually immature individuals made at the same place and at practically the same time (Hamburg, Michigan, October 10 and 12, 1924) totaled 260. Of this number 148, or 56.9 per cent, were females and 112, or 43.1 per cent were males.

All other juveniles collected in the years 1923 to 1928, of which the sex was determined, totaled 348. Of these, 201, or 57.8 per cent, were females and 147, or 42.2 per cent, were males.

Since these proportions check so closely (within less than one per cent), the specimens on which they are based may be united, making a total of 608 juveniles of both sexes. The per cent of females in this lot is 57.4 and of males 42.6, plus or minus a probable error of only 1.4 in each case.

These figures are summarized in the accompanying table.

Sex Ratios in Juveniles of Hemidactylium scutatum

Place and date of collection	Total number	Females	Males	Percentages, with probable errors	
				Females	Males
Hamburg, Oct. 10, 12, 1924	260	148	112	56.9±2.1	43.1±2.1
All *other* places and dates, 1923–28	348	201	147	57.8±1.8	42.2±1.8
All places and dates	608	349	259	57.4±1.4	42.6±1.4

Frank N. Blanchard, *Zoological Laboratory, University of Michigan, Ann Arbor, Michigan.*

THE WESTERN YELLOW-BELLIED RACER IN WESTERN WASHINGTON.—*Coluber constrictor mormon* is generally considered a snake of the sage brush areas rather than of the humid regions of western Washington. There are but few authentic records of this snake in western Washington so several recent observations may be of interest. The writer, during the past few years, has had several telephone conversations with persons who have described "unusual" snakes seen by them at different places in Pierce County. These various verbal descriptions have without doubt fitted the western yellow-bellied racer. On April 28, 1934, the writer observed one specimen near South Tacoma, but collection was impossible at the time. Identification was positive. It was not until May 6, 1934, that one was collected. This specimen, measuring 34.5 inches, was taken near Fort Lewis, Pierce County. This racer is apparently on the increase in western Washington, especially in the lower Puget Sound area.—Gordon D. Alcorn, *Tacoma, Washington.*

Ichthyological Notes

ON *TRACHURUS CAPENSIS* CASTELNAU.—Species of *Caranx*-like fishes belonging to the genus *Trachurus* are closely related and difficult to define. Nichols (1920),[1] recognized 11 species, among them *Trachurus capensis* Castelnau of the Cape Region of Africa on geographic grounds. Barnard (1927)[2] synonymized this with *Trachurus trachurus* (Linnaeus), as have other recent authors.

Ten specimens of *Trachurus* in the American Museum of Natural History, collected by Herbert Lang in southwest Africa (probably Walfisch Bay) about 1925, have recently been carefully studied. These agree with the description in Barnard so far as it goes, which description is presumably based on South African material, and we may assume that they represent the Cape Region fish. They have a greater number of dorsal rays than either *T. trachurus* of the Mediterranean or *T. semispinosus* (Nilsson) of northern Europe which is usually confused with it, are deeper bodied than the former and more slender than the latter. The only species recognized in 1920 from which I am unable to differentiate them is *T. mccullochi* Nichols, 1920, from Australian Seas, based on *Trachurus declivis*, McCulloch, 1915, not *Caranx declivis* Jenyns. Their accessory lateral line extends back under the second dorsal, a character not described for *declivis*, McCulloch. At least until *mccullochi* has been examined for this character, its identity with *capensis* will remain uncertain. However, *Trachurus mccullochi* of Australia should be synonymized with *Trachurus capensis* of South Africa, rather than the latter with *Trachurus trachurus* of the Mediterranean.

The ten specimens here referred to *Trachurus capensis* have dorsal soft rays, 31 to 34; anal, 26 to 30; scutes, 32 to 37 + 36 to 39, total 69 to 75; scutes on curve (front part) of lateral line parchment-like, unarmed; accessory lateral line extending back under second dorsal; opercular blotch and lining of gill-cavities black. Six of 197 to 220 mm length to base of caudal have depth in same, 3.6 to 4.0; head, 3.4 to 3.6; eye in head, 3.3 to 4.0; pectoral, 1.0 to 1.1; curve of lateral line in straight part, 1.25 to 1.5. Two of 265 and 285 mm have depth, 3.9 to 4.1; head, 3.5; eye, 3.9 to 4.2; pectoral, 0.9 to 1.0; curve lateral line in straight part, 1.35 to 1.4. Two of 390 and 408 mm have depth, 3.9 to 4.2; head, 3.3 to 3.6; eye, 4.5 to 4.8; pectoral, 1.1; curve of lateral line in straight part, 1.2 to 1.3. The largest specimens are somewhat different in appearance, tapering more in the tail region; this difference is presumably a function of size.—J. T. NICHOLS, *American Museum of Natural History, New York City.*

A NEW AMERICAN RECORD FOR THE SNIPEFISH (*MACRORHAMPHOSUS*).—I have before me a specimen of a snipefish (*Macrorhamphosus scolopax*), a species whose occurrence in the western Atlantic is sufficiently rare to make it noteworthy. This specimen, 10.2 cm. long, was taken by the trawler *Friendship* of New Bedford, Massachusetts, in late February or early March, 1935, at a depth of 30 to 40 fathoms, 60 miles southeast of Cape May Light, New Jersey; and was sent to the U. S. Fishery Station at Woods Hole, Massachusetts, by Mr. Sheldon Kent, a member of the crew.

The earliest and for many years the unique record for this species in the western Atlantic was that of Storer who at a meeting of the Boston Society of Natural History held April 1, 1857, presented a specimen caught at Provincetown, Massachusetts.

In 1904, I reported[3] the capture in 1902 of four specimens in the Gulf Stream off Key West, Florida, by the steamer *Fish Hawk*, at two stations at depths of 98 and 109 fathoms. This record was overlooked by Jordan, Evermann, and Clark in their Check List (1928), in which the only reference to the fish in the western Atlantic appears to be to the specimen recorded by Storer.—HUGH M. SMITH, *U. S. Fishery Laboratory, Woods Hole, Massachusetts.*

[1] Bull. Amer. Mus. Nat. Hist., 42: 477, 479.
[2] Ann. Sou. Afr. Mus., 21: 531.
[3] Science (n.s.) 19, 1904: 314.

Reviews and Comments

HALF MILE DOWN. By William Beebe. Harcourt, Brace & Co., New York, 1934: i–xix, 1–344, figs. 1–123. $5.00.—After quoting as his "Apologia" a delightful passage from William Morton Wheeler's *An Entomologist in Hades*, William Beebe, by his magic pen, whirls us from the origin of life on earth to the First Wonderer; then the "Thinker"; finally on through Columbus and Magellan to the explorers of the submarine waters, all climaxed of course by Beebe's own half-mile descent. The author graphically recounts the rôle of water in human environment; epics of water exploration; adaptations of air-breathing animals to a submerged existence, along patterns anticipating the several devices for human submergences. Another chapter amusingly tells of descents beneath the sea by Mr. Beebe's ancient precursors, including Alexander the Great who witnessed a submarine monster which brought its tail into view only after three days of swimming by at the speed of lightning. Proto-bathyspheres are described; then the helmet-diving which led the author to descend to greater depths, in the bathysphere invented by Otis Barton.

The second half of the book is devoted to accounts of this bathysphere: of its conception, development, construction, and accessories; of its dives; of the weird light penetrating to great depths, and of the blackness, farther down, broken only by animal light; of the organisms seen through the windows of the bathysphere.

Among the animals faintly seen through the bathysphere windows were several that were thought to be fishes, and that were described, figured and named. Some months previously Mr. Beebe based the most notorious of these names, *Bathysphaera intacta*, on a vision of lights: one supposed to represent a luminous barbel; others, in a row, assumed to represent the ventrolateral photophores of a fish and estimated to be about twice as long as any known fish with this general type of illumination; and one more light, figured as identical with the barbel bulb, and as dependent from an (unseen) anal fin. May this second light not have been produced in the barbel of a second stomiatoid fish possessing the hinder half of the row of lights, and closely followed the first fish, which might therefore be formally designated the holo-ideo-duplo-type? Three other new marvels were described and figured in this book, and about simultaneously in *The National Geographic Magazine* and in *The Bulletin of the New York Zoological Society*. Of these, *Bathyembryx istiophasma* and *Bathyceratias trilychnus* are each obviously based on an actual fish, probably a cetomimid and a ceratiid respectively. The third new name, *Bathysidus pentagrammus*, the Five-lined Constellation-fish, has as its type the faint vision of a roundish fish (?) with five gracefully curved lines of golden lights each set in a tiny circle of purple bulbs, all so utterly at variance with any known system of fish photophores that I am forced to suggest that what the author saw might have been a phosphorescent coelenterate whose lights were beautified by halation in passing through a misty film breathed onto the quartz window by Mr. Beebe's eagerly appressed face. My limitations prevent me from naming that kind of type.

Since accounts of these three additional *Bathy*-fishes appeared almost simultaneously in this book and in the magazine and the zoological journal quoted above, I have sought to determine which publication appeared first. The author wrote, under date of December 16 last, "The Z. S. Bulletin is dated November 20th 1934 & a few were sent out even before that date. The Nat. Geo. Mag. is dated Dec 1st, & was sent slightly earlier not to conflict with my book, the date of which was Dec 6th." George W. Hutchinson, Secretary of the National Geographic Society informed me that the December number of the National Geographic Magazine was mailed to far foreign addresses November 13 and that the mailing was completed on a graduated schedule November 28. The editorial office of the New York Zoological Society advised through a New York correspondent that its Bulletin, dated merely November-December, was mailed on December 5, a week or so after the National Geographic Magazine appeared in New York. Critically comparing all these dates, I conclude that the National Geographic Magazine carried the type descriptions of these three new genera and species. Carl L. Hubbs, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

NOTICES OF BOOKS OF INTEREST TO ICHTHYOLOGISTS.—There have appeared during the past several months a considerable number of books on fishes, or on related subjects of interest to ichthyologists. All of these should receive a more extensive review in COPEIA, with critical and detailed comments, but the pressure for publishing original articles has been too great to justify the requisite allotment of space. A number of the books should have been noticed more promptly than the limited available space and the preoccupation of the ichthyological editor in field work and other duties have permitted.

FISHES AND THEIR WAYS OF LIFE. By Louis Roule. Translated from the French by Conrad Elphinstone. W. W. Norton & Co., New York, 1935: i–viii, 1–312, figs. 1–52. $3.75.—This translation of a second book by Professor Roule must be a fine literary product, for it is so acclaimed by newspaper review critics and has been selected by the Scientific Book Club. It has even lured the very prosaic Ichthyological Editor of COPEIA away from more technical literature. He has marvelled how ichthyological material that could easily have been cramped into 50 pages on the dictum of scientific writing, "the greatest brevity consistent with clarity," has been inflated to 300 pages. He has recalled splendid scientific contributions, of only 10 to 20 pages, that he has been forced for lack of space to return to their authors, and has wondered whether this is an unjust world, or whether we scientists take ourselves too seriously. *Fishes and Their Ways of Life* is a largely unorganized series of essays, apparently not even attempting a comprehensive treatment of the subject. It is based almost exclusively on fishes personally observed by the author in southern Europe and northern Africa. In fact, it displays little familiarity with fishes of other regions. It is too frequently marred by inaccurate or incomplete statements. Throughout the book literary effect is more evident than critical judgement, legitimate conclusions and actual facts. Imagination is little hampered, as in describing the flight of the flying gurnard. Mystery is played upon, as in denying advantageous relationship between structures and functions, and in attributing evolution to formative, internal energies.

THE NATURAL HISTORY OF THE HERRING OF THE SOUTHERN NORTH SEA BEING THE BUCKLAND LECTURES FOR 1933. By William C. Hodgson. Edward Arnold & Co., London, (American Agents, Longmans, Green & Co., New York City) 1934: 1–120, 1 map and figs. 1–10. 3/6 (England) or $1.40 (America).—Science's only hope of escaping a Tower of Babel calamity is the preparation from time to time of works which summarize and which popularize the endless series of disconnected technical contributions. Mr. Hodgson has successfully done these services for a subject to which he has been a leading contributor. After a prefatory biography of Francis Trevelyan Buckland, this booklet treats the age determination of fishes in general and of herring in particular; the distribution, life-cycle and spawning of this fish; the fluctuations of the catch, and their causes; the fishery biology in general of the North Sea herring.

ANGLING SUCCESS. By Leading Outdoor Writers. Edited by Mortimer Norton. Macmillan Co., New York City, 1935: i–xxii, 1–291, illustr. $2.50.—Written by outstanding present-day anglers and writers, this book as would be expected is an interesting and up-to-date discussion of the leading American game fishes, and of the angling lore surrounding them. This lore contains much valuable information, some of which has not been absorbed by ichthyologists. The book also contains somewhat more than a modicum of misinformation, but this is usually quaint and interesting. Much of this misinformation, plus some simple mistakes, could have been culled by a well-informed ichthyologist. It is distinctly superior to most angling books, though hardly reaching the standard set by James Alexander Henshall.

LIMNOLOGY. By Paul S. Welch. McGraw-Hill Book Co., New York and London, 1935: i–xiv, 1–471, figs. 1–46. $5.00.—This book is the first general treatise on limnology in the English language, but has a comprehensiveness and accuracy which belies its pioneer status. It is essentially a thorough digest and coordination of a large, heretofore scattered literature, accompanied by an almost bewildering classified bibliography. The subject is given broad limits, covering the physiography, physics, chemistry and biology of both standing and running fresh waters. The chapter on biological productivity will be especially useful to fishery biologists, although the end stage, of fish production in kilo-

grams per hectare or pounds per acre, is hardly mentioned. In fact the fish and fishery bearings of limnology are largely neglected. The term lenitic is misspelled "lentic."

MAN AND THE VERTEBRATES. By Alfred Sherwood Romer. University of Chicago Press, Chicago, 1934: i–vii, 1–427. $3.00.—Anthropocentric without being teleological, this treatise expands in geometric ratio from fish to man: the origin of the vertebrates and the evolution of fishes are passed with a few words; the origin of the land vertebrates and the history of the reptiles is discussed more fully; the second half of the book is about equally divided between the origin, history and structure of the mammals and of man, respectively. The treatment is clear and forceful; definite, at times varying toward dogmatic; simplified, but hardly monosyllabic; non-technical, for scientific names are largely omitted, some by strained effort. Dr. Romer has done a fine job with an immense subject.—CARL L. HUBBS, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

LEITFADEN ZUR PFLEGE UND ZUCHT VON EINHEIMISCHEN UND FREMLÄNDISCHEN ZIERFISCHEN, SEETIEREN, SCHNECKEN UND WASSERPFLANZEN NEBST EINEM ANHANG ÜBER TROCKEN- UND KUNSTFISCHFUTTERARTEN. By Wilhelm Schreitmüller. Third edition. Georg Müller, Frankfurt-am-Main, 1934: xxiv + 328 pp., 235 figs., 24 colored plates. This book, which bears on its paper cover the title "Zierfische, Seetiere, ihre Pflege und Zucht," is interesting chiefly as one of the most popular and comprehensive of the German books on aquarium fishes. It takes up marine fishes and invertebrates, and aquarium plants more extensively than most. The figures are the same ones that have greeted us in nearly every German aquarium book published in the last 20 years. The book is much larger than the first edition, which appeared in 1928.—GEORGE S. MYERS, *U. S. National Museum, Washington, D. C.*

DIE AQUARIENFISCHE IN WORT UND BILD. By Max. Holly, Hermann Meinken, and Arthur Rachow. Julius E. G. Wegner, Stuttgart-Winnenden, 21 × 18.5 cm. Published in parts of 10 signatures, loose-leaf. Lieferungen 1–2, 1934.—The taxonomist and general biologist is becoming more and more interested in small aquarium fishes because of the growing use of these little creatures in experimental biology, in teaching, and in anti-mosquito work in the tropics. The literature on these fishes and their habits, particularly in the German aquarium journals of the last 30 years, is very large, but it has largely been inaccessible due to the lack of an adequate index to it in any publication. The present work supplies this to a considerable degree, in the form of synonymic references under each species. The work is being published in parts, loose-leaf, as the accounts are turned in by the authors, the various pages to be rearranged in systematic order at the completion of the whole. The account of each species is by one of the three authors, all of whom are competent specialists. Two pages are given to each family heading, and usually two to each species, including a figure, list of references, habitat, description, care and breeding, and general biological notes. The figures are mostly from drawings previously published in the German journals. On its completion, this work will probably be the most complete and useful summary of aquarium fishes and their literature available to biologists.—GEORGE S. MYERS, *U. S. National Museum, Washington, D. C.*

THE REPTILES OF CHINA. By Clifford H. Pope. Volume 10 of the Natural History of Central Asia, Final Reports of the Central Asiatic Expeditions of the American Museum of Natural History. 1935: LII + 604, fig. 1–77, pl. 1–27. $10.00.—It is a relief to turn from the perusal of the endless stream of short papers on taxonomic herpetology to a volume which summarizes the accumulated research of years and offers a matured opinion on the faunal and taxonomic problems involved. Such works as the new edition of the amphibian and reptile volumes in the *Fauna of British India*, with the fortunate choice of Dr. Malcolm A. Smith to prepare them, H. W. Parker's competent "Monograph of the Microhylidae," and now the fine volume by Clifford H. Pope on the "Reptiles of China," in the series of final reports on the results of the Central Asiatic Expeditions of the American Museum of Natural History, exhibit most clearly the great value of this combination of research with compilation and summary. The fact that even the European and North American herpetological faunas are less well summarized than are the Chinese and Oriental in these new works,

and that no modern comprehensive works exist for any of the other major faunal areas of the world, exhibits only too clearly how few are the competent taxonomists in this field, and how urgent it is that such large scale projects be promoted and carried to completion.

"The Reptiles of China" presents a full account, with descriptions of species and keys to the genera and species, of the twenty-two species of turtles, the single crocodilian, and one hundred and thirty species and subspecies of snakes recognized. This occupies, with the introductory account of Mr. Pope's explorations in China and general chapters on the ecology and secondary sex characters of snakes, 453 pages; limitations of space have accordingly made necessary the compression of the treatment of lizards to the check-list of the sixty-six species, occupying 33 pages.

A major usefulness of the work will be the stimulus to further studies in China and especially the establishment of a firm foundation for the work of the active school of herpetologists which has arisen in China itself in recent years. The value to Chinese students of the careful synonymies, worked out by study of typical material and by consultation with other specialists in this field, and of the original descriptions and republished plates, is inestimable. The generally conservative treatment of the problems of subdivision of variable forms into subspecies sets an excellent example, perhaps not only to the Chinese herpetologists. A most fruitful field of study, with Pope's work as a basis, will be the mapping of distributions and their correlation with environmental factors. This in turn will lead to a renewed analysis of the widespread forms into series of valid subspecies.

Herpetologists interested in other faunae will examine the style of treatment with interest, and will turn especially to the chapters on habitat preference and breeding habits, and on the secondary sex characters of snakes. The renewed interest in the hemipenial characters of snakes stimulated by the work of E. R. Dunn on the American genera is reflected in the careful descriptions of these characters in the present volume. These structures have provided the key to the discrimination of species in certain difficult genera, such as *Trimeresurus*.

The connection of Clifford H. Pope with Chinese herpetology, beginning in 1921, has been a most fortunate one, and his first hand knowledge of the geography of China and of his material in field and laboratory is now unrivalled. This direct personal knowledge of the matter in hand lends value to every page of the present volume. Instead of leaving the student with the feeling that this work closes the subject, he is shown the open avenues for continued investigation which can be built upon it.

Herpetologists everywhere will regret that the plan of the series of monumental volumes on the vertebrate fauna of China resulting from the work of the Asiatic Expeditions under the leadership of Dr. Andrews does not include a volume on the Amphibia, on which Mr. Pope is the acknowledged authority.—KARL P. SCHMIDT, *Field Museum of Natural History, Chicago, Illinois.*

A MONOGRAPH OF THE FROGS OF THE FAMILY MICROHYLIDAE. By H. W. Parker. British Museum. 1934.—This book of 208 pages on a very difficult group adds the narrow-mouthed toads to the four families of Reptiles and Amphibians which have been given modern monographic treatment (Hynobiid and Plethodontid salamanders, Lacertid lizards, and seasnakes).

The family has been redefined, and restricted to a natural group by the elimination of a number of genera. In this connection a synopsis of the characters of the various firmisternal families is given. In some respects the family shows more primitive characters than the Ranidae, and the two are believed to have had a common ancestor.

Seven subfamilies are recognized, as against fourteen recognized by Noble. Two are confined to the East Indies (mostly east of Wallace's line), one to Africa, and one to Madagascar, while the most primitive group, the Dyscophinae, is found in Madagascar, Southeast Asia, Sumatra and Borneo; the highly modified Melanobatrachinae in East Africa and in Southern India; and the Microhylinae (with 16 of the 43 genera) in America, southeast Asia, and the islands as far as Celebes and Flores. Two new genera and 8 new species are described: 179 species and 184 forms are recognized: 152 of the

forms have been examined. Since publication Loveridge has synonymized two of the species and Wettstein has described a new one.

Taxonomically and anatomically the work commands admiration. The family, the subfamilies, and the genera emerge from the anatomical consideration of the species, as they should, and the book is a beautiful vindication of this method as against the more spectacular (but unsound) use of arbitrary "generic characters" and "family characters."

American Herpetologists will be more immediately concerned with the treatment of American forms. First comes the matter of the family name. Parker goes back to Fitzinger, who in 1843 for the first time utilized the names of genera based on species of this family as root words for larger groups. He employed *Hylaedactylus* (type *baleata*) and *Gastrophryne* (type *carolinensis*). The first reviser should choose between two names of equal date. Parker seems to be the first person to choose between any names of supergeneric rank based on genera including *baleata* or *carolinensis*. He has chosen the genus including *carolinensis*, which is *Microhyla*. This is logical enough, but Fitzinger's terms were Hylaedactyli and Gastrophrynae, which does not conform to the Code statement that such terms should have the -idae or the -inae form. Günther, in 1858, first employed the ending -idae for higher groups containing genera based on species now in the family. He employed *Asterophrys* (type *turpicola*). *Engystoma* (type *gibbosa*), *Microhyla* (type *achatina*), and *Hylaedactylus* (type *baleata*). The first reviser of this action seems to have been Cope, who used Engystomidae in 1865, and certainly Boulenger in 1882 did likewise. If the first family names are Fitzinger's, then the family is based on *carolinensis*, and should be called Microhylidae. If Günther's are the first family names (which I am inclined to believe), then the family is based on *gibbosa*, and should be called Brevicipitidae, as *Breviceps* is the oldest generic name including *gibbosa*, just as *Microhyla* is the oldest name for the genus containing *carolinensis*.

The 26 American species, all in the subfamily Microhylinae, (now 27 with Wettstein's *Hypopachus parkeri* from Rio) are divided into seven genera. *Hypopachus*, with six species, represents a relatively primitive type. *Microhyla*, with eleven, is a relatively specialized form. There can be no question but that congeneric species of the latter occur both in America and in Asia. The best possible division of Parker's genus *Microhyla* would be one which put those with umbrella-mouthed tadpoles in one genus, and the rest in another. Such a division would give: *Microhyla* (type *achatina*) for *achatina* and *heymonsi*, both Asiatic; and *Gastrophryne* (type *carolinensis*) for the other 24 species, 11 of which are American and 13 Asiatic. This peculiar situation is tentatively explained by Parker as the result of two immigrations. The first brought primitive forms which are now generically distinct; the second brought the more specialized *Microhyla*, and no generic differentiation has taken place. His explanation seems reasonable to me, and, as he remarks, there are many cases of generic identity when one considers the herpotological fauna of southeast Asia, the southeastern United States, or Central America. Certainly the Javanese *achatina* and *palmipes*, and the American *carolinensis*, the three which I have seen in the field, are closely similar.

It may be of interest to add that the North American genera are: *Elachistocleis* (one species) which reaches Panamá; *Hypopachus* (six species, four North American); *Microhyla* (eleven species, seven North American).

I should have welcomed statements, even if quoted, about habits, calls, habitats, etc., which, if they are not included in a monograph are never gathered together anywhere. This would have increased the size of the book somewhat, but it seems to me eminently worthwhile doing, and I endeavored to do it in my own two monographs of families. Parker omits these matters intentionally, and I rather regret the omission, which is, indeed, the only quarrel I can find with a piece of work which I so wholeheartedly admire and recommend to all students of Herpetology. There is an index. —E. R. DUNN, *Haverford, Pennsylvania.*

EDITORIAL NOTES AND NEWS

Summary of the 1935 Meeting

THE eighteenth annual meeting of the AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS was held at the Carnegie Museum, Pittsburgh, Pennsylvania, from Thursday, May 2 to Saturday, May 4, 1935.

Sessions of May 2

THE opening session was called to order by Vice-President HARPER at 9:45 A.M. in the Lecture Room of the Children's Museum. There were 27 members present when the session opened, but the attendance rapidly increased and averaged about 50 at most of the sessions. The following papers were read and discussed:

1. **The Herpetological Collections of the Carnegie Museum**—M. Graham Netting.
2. **The Care of the Bushmaster, and of Certain Lizards in the New York Zoological Park**—Raymond L. Ditmars and Arthur M. Greenhall.
3. **Some Histological Observations of Larval Transplants in Adult Triturus viridescens viridescens**—H. Idzkowsky.
4. **The Ateleopidae Family and its West Indian Form**—Luis Howell Rivero.
5. **The Panama Snake Census**—E. R. Dunn.
6. **The Feeding Habits of Chinese Snakes**—Clifford Pope.
7. **The Composition and Origin of the Yucatan Herpetofauna**—L. C. Stuart.
8. **The Salamanders of Guatemala**—Karl P. Schmidt.

The morning session adjourned at 12:30 and the members assembled for a photograph. Following this, the members joined those of the American Society of Mammalogists for luncheon in the Museum Cafeteria.

Business Session

THE annual business meeting was called to order by Vice-President POPE at 2:25 P.M. with 26 members present, including 11 Governors. The minutes of the previous meeting were read and approved.

The SECRETARY reported that 37 new members were obtained during the year, 13 members resigned, and 19 were dropped for non-payment of dues, which resulted in a net gain of 5 members for the year and which increased the total membership to 355. Twelve new subscribers were obtained and 3 subscriptions were discontinued, which resulted in a gain of 9 subscribers and brought the total number of subscribers to 78. The total of members and subscribers stands at 433, an increase of 14 over the total of the preceding year. A geographical analysis of the members and subscribers indicated 79 copies of COPEIA go to 20 foreign countries, with Canada leading with 23, and England and the U.S.S.R. following with 7 each. The domestic copies total 354, which are distributed in 39 states and the District of Columbia, 61 in New York, 47 in California, 30 in Michigan, and 24 in Massachusetts. The SECRETARY promised to prepare during the coming year a mimeographed address list of the members of the Society in order to stimulate the securing of new members.

In the absence of the TREASURER, the SECRETARY summarized briefly the financial condition of the Society. An analysis based upon the complete Treasurer's report is given here. The balance on hand, May 5, 1934, was $923.10. Receipts for the period from this date to May 2, 1935, were $1,635.37, distributed as follows: contributions toward publication, $74.00; annual dues, $972.69; annual subscriptions, $191.14; suspense, $.05. Expenditures for the same peried amounted to $1,635.91, allocated as follows: publication of COPEIA (four numbers), $1,277.68; cost of reprints, $238.52; photostating back numbers, $61.95; postage, $34.00; printing, $18.15; miscellaneous, $5.61.

In an informal EDITORS' report, MRS. GAIGE expressed appreciation to the members for their patience with the Editors and for their helpful suggestions. The fact was stressed that authors who have paid a part or all of their publication costs have done so voluntarily to secure immediate publication or the acceptance of papers of more than average length. Consequently subsidized articles do not come under the normal publication budget, and thus add to the size of COPEIA instead of occupying space allotted to regular

articles. On being requested for opinions on certain matters of editorial policy, the members expressed their approval of brief reviews, but not of lists of current literature.

There were no reports from standing committees. DR. DUNN, Chairman of the Nominating Committee, was called on for a report, which he prefaced with the statement that nominations from the floor, in addition to those proposed by the committee, were in order. The officers proposed for the ensuing year by the Nominating Committee were: LEONHARD STEJNEGER and JOHN T. NICHOLS, *Honorary Presidents*; CLIFFORD H. POPE, *President*; HENRY W. FOWLER, TRACY I. STORER, and E. H. TAYLOR, *Vice-Presidents*; M. GRAHAM NETTING, *Secretary*; A. W. HENN, *Treasurer*; CARL L. HUBBS and HELEN T. GAIGE, *Editors*. There were no additional nominations and the report of the committee was unanimously accepted.

The SECRETARY announced that invitations for the 1936 annual meeting had been received from the Philadelphia Academy, from the Museum of Zoology of the University of Michigan, and from the Florida Reptile Institute, but he proposed, in view of the many peculiar factors which must be taken into consideration prior to a decision that the question of the place of next year's meeting be left to the Board of Governors for settlement. After some discussion, Mr. Schmidt moved that the decision be left to the Board of Governors, and the motion was duly carried.

In view of suggestions made by members prior to the meeting, the SECRETARY proposed an amendment to the by-laws based upon an article in the tentative constitution, previously prepared by DRS. GREGORY and NOBLE. After discussion the following amendment was passed: *Resolved*, that Article III, Section 1, be amended to read as follows: "The Society shall consist of Active Members and Honorary Members. Active members shall consist of those interested in the study of cold-blooded vertebrates who pay the annual dues. Honorary members shall be chosen from among the ichthyologists and herpetologists, located outside of the United States, who have attained distinction as investigators. The number of Honorary Members shall not exceed ten, shall be equally divided between ichthyologists and herpetologists, and not more than two shall be elected in any year." It was suggested that the Board of Governors elect the first two.

The 37 new members proposed during the year, were formally elected. The SECRETARY read a cable from DR. HUBBS in which he expressed his regrets at missing the meeting. DR. TAYLOR delivered DR. STEJNEGER's best wishes and a similar expression of regret that he could not attend the meeting.

After the adjournment of the business session, the following papers were presented:

9. **The Osteology and Relationships of the Phallostethid Fishes**—R. J. Bailey.
10. **Notes on Ambystoma mabeei Bishop**—Harry G. M. Jopson.
11. **Larval Grafts on Adult Triturus**—S. H. Wright.
12. **Our 1934 Herpetological Transcontinental Jaunt**—A. H. Wright.

The combined annual dinner of both societies was held at the Hotel Schenley at 7 P.M. The dinner was followed by a short address of welcome by EX-GOVERNOR FISHER of Pennsylvania, and then the members were entertained by DEAN SAGE, JR., who gave an illustrated talk, "Hunting Trails of Far West China," and by MRS. LUCIE CHAPMAN, who showed magnificent moving pictures of Rocky Mountain mammals taken by Mr. Chapman and herself.

Sessions of May 3

13. **Hybrids and Intergrades**—E. R. Dunn.
14. **The Ancient Herpetological Fauna of Kansas**—Edward H. Taylor.
15. **The Breeding of Esox in the Michigan Inland Lakes**—T. L. Hankinson.
16. **The Redbellied Watersnake in Pennsylvania**—E. R. Dunn and R. Allen.
17. **Variations in the Genus Chrysemys in the eastern United States**—Norman E. Hartweg.

Following the morning session, a short business meeting was convened to discuss a resolution introduced by DR. A. AVINOFF, Director of the Carnegie Museum. After short discussion, this motion was passed: *Whereas*, the proper listing of type specimens is of great importance to all scientific workers, *Therefore*, be it resolved that it is deemed desirable to encourage the preparation of lists of type specimens preserved in collections of public institutions as one of the moral obligations of such institutions before the scientific world and as part of an eventual international program to this effect; and that it is also found desirable to stimulate practical efforts toward a more ambitious and inclusive project of a general *Corpus Typorum* as a collation of such data throughout the world to be available to scientists.

After luncheon, the following papers were presented:

18. **A Preliminary Report on the Snakes of the Genus Sonora**—Wm. H. Stickel.
19. **The Occurrence of Albinos in a Brood of the Common Water Snake, Natrix sipedon sipedon** Linn.—William M. Clay.
20. **Distribution and Variation in Natrix cyclopion, with the Description of a New Subspecies**—C. C. Goff.
21. **Proposed Changes in Nomenclature in Species of the Genus Eumeces**—Edward H. Taylor.
22. **Some Trematode Parasites of Triturus viridescens viridescens**—Ruth S. Kelly.
23. **The Distribution of Amphibians in Ohio**—Charles F. Walker.
24. **Taxonomy of the American Salamanders of the Genus Triturus**—Harry G. M. Jopson.

At 4 P.M. the members visited the Zoology Department of the University of Pittsburgh, where they were shown demonstrations of the experimental work which is being carried out on the newt. During this visit to the University, members were also conducted to the top of the Cathedral of Learning for a view of Pittsburgh.

At 8 P.M. DR. AVINOFF delivered a lecture to the members of both societies in the Lecture Hall of the Carnegie Museum on "Animal Portraiture" or "From Cave Dwellers to Futurists." Following the lecture, an informal smoker was held in the Museum.

A number of the members availed themselves of the opportunity to visit a steel mill in the Pittsburgh district on the following day (May 4). A considerable number, however, remained to examine specimens in the laboratories of the Carnegie Museum.

News of Herpetologists

HERPETOLOGICAL collectors in Mexico this summer include DR. BERRY CAMPBELL and his wife, in Sonora; JAMES OLIVER, in Colima, and MORROW ALLEN, on Mujeres and Cozumel islands, sponsored by the Museum of Zoology, University of Michigan. HOBART SMITH, Kansas State Museum, is making a trip down the west coast to add further material to the splendid Mexican collection of the Dyche Museum.

ROGER CONANT, formerly with the Toledo Zoological Society, has accepted the position of Curator of Reptiles in the Philadelphia Zoo.

CLIFFORD H. POPE, having completed his fine monograph "The Reptiles of China" (see Reviews), is at present giving most of his time to ichthyology in the American Museum of Natural History's Department of Fishes, which is a field that he has not worked in for several years.

Ichthyological Items

THE Guggenheim Memorial Foundation has renewed for another year the Latin-American fellowship granted Dr. LUIS HOWELL RIVERO of the University of Havana, allowing him to continue his taxonomic studies of West Indian fishes, principally at the Museum of Comparative Zoology. He is temporarily working now at the University of Michigan, revising the Cuban Cyprinodontes.

Dr. GEORGE S. MYERS, Curator of Fishes, U. S. National Museum, spent part of July at the University of Michigan, chiefly in conection with a project, on which he has been engaged since assuming his present position, of monographing the fishes of Virginia.

The Petén expedition, one of those sponsored jointly by Carnegie Institution of Washington and the University of Michigan, has returned with a large collection of fishes and mollusks, from Lake Petén, several other lakes, Río San Pedro and from the Río de la Pasión in Alta Vera Paz as well as Petén.

Dr. J. D. T. HARDENBERG, ichthyologist of the Laboratorium voor het Onderzoek der Zee at Batavia, Java, is returning for a nine-months leave in Holland, where his address will be Haviklaan 25, The Hague.

American ichthyologists hear, with much regret, news of the death of Dr. DECIO VINCIGUERRA of the Genoa Museum, and of Dr. J. T. CUNNINGHAM. Dr. Cunningham, one of England's best known fishery biologists, died on June 5, at the age of 76 years.

Support of Copeia

FINANCIAL assistance toward the publication of this number of Copeia has been given by Stanford University, E. R. Dunn, George B. Meade, Ross F. Nigrelli, C. M. Breder, Jr., and Carl L. Hubbs.